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ESC 2925 94 01

60 MHz Single Time Base Oscilloscope PM3050

TEST & MEASUREMENT CUSTOMER SUPPORT

4822 872 05328
880411/2

Service Manual

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60 MHz Single Time Base Oscilloscope

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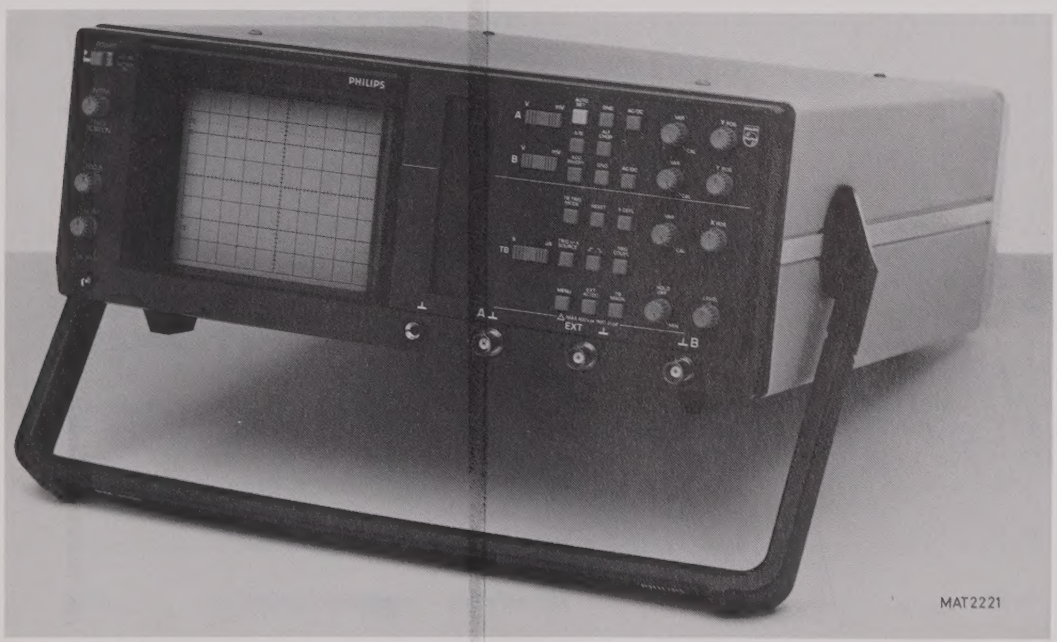

WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock do not perform any servicing other then that specified in the Operating Instructions unless you are fully qualified to do so.

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IMPORTANT: In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

NOTE: The design of this instrument is subject to continuous development and inprovement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

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1. SAFETY INSTRUCTIONS

Read these pages carefully before installation and use of the instrument.

1.1 INTRODUCTION

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.2 SAFETY PRECAUTIONS

For the correct and safe use of this instrument it is essential that both operating and servicing personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the manual.
Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

1.3 CAUTION AND WARNING STATEMENTS

CAUTION: is used to indicate correct operating or maintentance procedures in order to prevent damage to or destruction of the equipment or other property.

WARNING: calls attention to a potential danger that requires correct procedures or pracites in order to prevent personal injury.

1.4 SYMBOLS

High voltage ≥ 1000 V (red)

Live part (black/yellow)

Read the operating instructions

Protective earth (grounding) terminal (black)

1.5 IMPAIRED SAFETY-PROTECTION

Whenever it is likely that safety-protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. The matter should then be referred to qualified technicians.
Safety protection is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

1.6 GENERAL CLAUSES

1.6.1 WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to live.

1.6.2 The instrument shall be disconnected from all voltage sources before it is opened.

1.6.3 Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.6.4 WARNING: Any interruption of the protective earth conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.

1.6.5 Components which are important for the safety of the instrument may only be renewed by components obtained through your local Philips organisation. (See also section 15).

1.6.6 After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in section 15 have to be performed.

2. CHARACTERISTICS

A. Performance Characteristics

- Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.
- This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23°C).
- For definitions of terms, reference is made to IEC Publication 351-1.

B. Safety Characteristics

- This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety requirements for Electronic Measuring Apparatus, UL 1244 and CSA 556B and has been supplied in a safe condition.

C. Initial Characteristics

. Overall dimensions:

- Width

Including handle	: 387 mm
Excluding handle	: 350 mm

- Length

Including handle, excl. knobs	: 518,5 mm
Excluding handle, excl. knobs	: 443,5 mm
Including handle, incl. knobs	: 530,5 mm
Excluding handle, incl. knobs	: 455,5 mm

- Height

Including feet	: 146,5 mm
Excluding feet	: 134,5 mm
Excl. under cabinet	: 132,5 mm

Figure 2.1 Dimensions

* Mass : 7,5 kg

* Operating positions:

  a. Horizontally on bottom feet
  b. Vertically on rear feet
  c. On the carrying handle in two sloping positions.

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2.1. Display
2.2. Vertical deflection or Y axis
2.3. Horizontal deflection or X axis
2.4. Triggering
2.5. Power Supply
2.6. Auxiliary inputs or outputs
2.7. Environmental characteristics
2.8. Safety

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.1	DISPLAY		
	* CRT		
	Type No	PHILIPS D 14-372	
	Measuring area (h x w)	80 x 100 mm	8 x 10 div. 1 div. = 10 mm 1 subdiv. (sd) = 2 mm
	* Screen type		
	Standard	GH (P 31)	
	Option	GM (P 7)	Long persistence
	* Total acceleration voltage	16 kV	
	* Graticule		
	Engravings	Internal fixed	
	Division lines	1 cm	Horizontal as well as vertical
	Subdivisions	2 mm	Idem.
	Dotted lines	1,5 and 6,5 cm from top	Only horizontal.
	Percentages	0%, 10%, 90%, 100%	
	* Orthogonality	90^{o} +/- 1^{o}	Measured in zero point.
	* Illumination	Continuously variable	
	* Display time per channel in chopped mode	< 2 us	
	* LCD liquid crystal display		All relevant settings are visible in display.
	Type No	LC 9438130	
	Visible area	25,4 x 88,8 mm	
	Back lighting	Permanently on	
2.2	VERTICAL DEFLECTION OR Y AXIS		
	* Deflection coeff.	2 mV/div...10 V/div	In 1, 2, 5 sequence. If PM 8936/09 is used, deflection coeff. is automatically calculated in display
	* Variable gain control range	1 : >2,5	
	* Error limit	< +/- 3%	Only in calibrated position.
	* Input impedance	1 M ohm +/-2%	Measured at f_o < 1 MHz
	Paralleled by	20 pF +/-2pF	Measured at f_o < 1 MHz

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Max. input voltage	400 V (d.c. + a.c. peak)	
Max. test voltages (rms)	500 V	Max. duration 60 sec.
* Bandwidth for 20 mV...10 V	> 60 MHz (amb. 0...35°C)	Input 6 div. sine-wave.
Bandwidth for 2 mV, 5mV and 10 mV	> 35 MHz	Input 6 div. sine-wave.
* Rise-time	5,8 ns or less	Calculated from 0,35/f-3 dB
* Noise 20 mV...10 V	< 0,5 sd	Measured visually. Pick up on open BNC excluded.
* Lower - 3 dB point	< 10 Hz	In AC position, 6 div. sine-wave
* Dynamic range		
@ 1 MHz	> +/- 12 div.	Vernier in cal. position.
@ 50 MHz	> 8 div.	Vernier in cal. position.
* Position range	> +/- 8 div.	Vernier in cal. position.
* Decoupling factor between channels		Both channels same attenuator setting. Input max. 8 div. sine-wave.
@ 10 MHz	1 : > 100	2,5 and 10 V are excluded.
@ 50 MHz	1 : > 50	2,5 and 10 V are excluded.
* Common Mode Rejection Ratio @ 1 MHz	1 : > 100	Both channels same attenuator setting, vernier adjusted for best CMRR; measured with max. 8 div. (+/- 4 div.) each channel.
* L.F.Non Linearity	< 3%	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Visible signal delay	> 15 ns	Max. intensity, measured from line start to trigger point.
* Base-line jump between attenuator steps 20 mV...10 V	< 1 sd	
Additional jump between 10 mV <---> 20 mV	< 1,5 sd	
Normal Invert jump	< 1 sd	Only channel B.
ADD jump	< 0,6 div.	When A and B are positioned in screen centre (20 mV...10 V).
Variable jump	< 1 sd	Max.jump in any position of the vernier.

2.3 HORIZONTAL DEFLECTION OR X AXIS

2.3.1 Time Base

* Time coeff.	0,5 sec...50 ns	1, 2, 5 sequence (magn.off)
Error limit	< 3%	Measured at -4...+4 div. from screen centre.
* Horizontal position range	Start of sweep and 10th div. must be shifted over screen centre	
* Variable control ratio	1 : > 2,5	
* Time Base magnifier	Expansion *10	Not valid in X-deflection.
Error limit	< 4%	Measured at +4...- 4 div. from screen centre. Excluding first 50 ns and last 50 ns.
* Horizontal magnifier balance * 10 ---> * 1	< 2,5 sd	Shift start of sweep in * 10 in mid-screen position, then switch to * 1.
* Hold-Off Minimum to maximum hold-off time ratio	1 : > 10	Minimum hold off time is related to time base setting.

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.3.2	X-deflection		
	* Deflection coeff. Via channel A or B	2 mV/div...10 V/div	1, 2, 5 sequence.
	Via EXT. input	100 mV/div.	
	* Error limit Via channel A or B	< +/- 5%	
	Via EXT. input	< +/- 5%	
	* Bandwidth	DC .... > 2 MHz	DC coupled
	* Phase shift between X and Y-deflection	< 3^{o} @ 100 kHz	
	* Dynamic range	> +/- 12 div. @ 100 kHz	
2.3.3	EXT input		
	* Input impedance	1 M ohm +/- 2%	f_o < 1 MHz
	Paralleled by	20 pF +/- 2 pF	f_o < 1 MHz
	* Max. input voltage	400 V (d.c. + a.c. peak)	
	Max. test voltage (rms)	500 V	Max. duration 60 sec.
	* Lower - 3 dB point	< 10 Hz	AC coupled
2.4	TRIGGERING		
	* Trig.mode AUTO (auto free run)	Bright line in absence of trigger signal	Auto free run starts 100 ms (typ.) after no trig.pulse.
	Triggered		Switches automatically to auto free run if one of the display channels is grounded.
	Single		In multi-channel mode (alternated) each channel is armed after reset; if sweep has already started, sweep is not finished. Not applicable in peak to peak coupling.
	* Trigger source A, B, Composite (AB), EXT, Line		Line trigger source always triggers on main frequency. Line trigger amplitude depends on line input voltage. Approx. 6 div. @ 220 VAC input voltage.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Trigger coupling Peak-to-peak (p-p), DC, TVL, TVF		
* Level range		
Peak-to-peak	Related to peak-to-peak	p-p coupling is DC rejected.
DC INTERNAL	> (+ or - 8 div.)	
DC EXTERNAL	> (+ or - 800 mV)	
TVL/TVF	Fixed level	
* Trigger slope	+/-	Slope sign in LCD and + or - if TVL/F in chosen for positive or negative video
* Trigger sensivity		
INTERNAL		
0 - 10 MHz	< 0,5 div.	Trig. coupling DC.
@ 50 MHz	< 1,0 div.	Trig. coupling DC.
@ 100 MHz	3,0 div.	Trig. coupling DC.
EXTERNAL		
0 - 10 MHz	< 50 mV	Trig. coupling DC.
@ 50 MHz	< 150 mV	Trig. coupling DC.
@ 100 MHz	500 mV	Trig. coupling DC.
TVL/F INTERNAL	< 0,7 div.	Sync. pulse.
EXTERNAL	< 70 mV	Sync. pulse.

2.5 POWER SUPPLY

* Line input voltage AC		One range.
Nominal	100 - 240 V	
Limits of operation	90 - 264 V	
* Line frequency		
Nominal	50 - 400 Hz	
Limits of operation	45 - 440 Hz	
* Safety requirements within specification of : IEC 348 CLASS I UL 1244 VDE 0411 CSA 556 B		

* Power consumption 45 W

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.6 AUXILIARY INPUTS OR OUTPUTS		
* Z-MOD		TTL-compatible.
ViH	> 2,0 V	Blanks display.
ViL	< 0,8 V	Max. intensity Analogue control between ViH and ViL is possible.
* DIN plug 9-pin (female)		For IEEE control, front-panel memory back-up.
* CAL		To calibrate drop or tilt probes.
Output voltage	1,2 V +/- 1%	Rectangular output pulse.
Frequency	2 kHz	
The output may be short-circuit to ground.		
2.7 ENVIRONMENTAL CHARACTERISTICS		
The environmental data mentioned in this manual are based on the results of the manufacturer's checking procedures. Details on these procedures and failure criteria are supplied on request by the PHILIPS organisation in your country, or by PHILIPS, INDUSTRIAL AND ELECTRO-ACOUSTIC SYSTEMS DIVISION, EINDHOVEN, THE NETHERLANDS.		
* Meets environmental requirements of:	MIL-T-28800 C, type III, CLASS 5 Style D	
* Temperature		
Operation temp. range within specification	10...40°C	MIL-T-28800 C par. 3.9.2.3. tested, par. 4.5.5.1.1.
Limits of operation temperature range	0 ...50°C	Idem.
Non-operating (Storage)	- 40°C/+ 75°C	MIL-T-28800 C par. 3.9.2.3. tested, par. 4.5.5.1.1.
* Max. humidity		
operating	95% RH	10...30°C
non-operating		
* Max. altitude		MIL-T-28800 C par. 3.9.3. tested, par. 4.5.5.2.
Operating	4,5 km (15000 feet)	Maximum (Operating Temperature derated 3°C for each km, for each 3000 feet, above sea level).
Non-operating (storage)	12 km (40 000 feet)	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Vibration (operating)		MIL-T-28800 C par. 3.9.4.1. tested, par. 4.5.5.3.1.
Freq. 5...15 Hz	7 min.	
Sweep Time		
Excursion (p-p)	1,5 mm	
Max Acceleration	7 m/s^2 (0,7 x g)	@ 15 Hz
Freq. 15...25 Hz	3 min.	
Sweep Time		
Excursion (p-p)	1 mm	
Max Acceleration	13 m/s^2 (1,3 x g)	@ 25 Hz
Freq. 25...55 Hz	5 min.	
Sweep Time		
Excursion (p-p)	0,5 mm	
Max Acceleration	30 m/s^2 (3 x g)	@ 55 Hz
Resonance Dwell	10 min.	@ each resonance freq. (or @ 33 Hz if no resonance was found). Excursion, 9.7.1. to 9.7.2.
* Shock (operating)		MIL-T-28800 C par. 3.9.5.1. tested, par. 4.5.5.4.1.
Amount of shocks		
total	18	
each axis	6	(3 in each direction).
Shock Wave-form	Half sine-wave	
Duration	11 ms	11 ms
Peak Acceleration	300 m/s^2 (30 x g)	
* Bench handling		Mil-T-28800 C par. 3.9.5.3. tested, par. 4.5.5.4.3.
Meets requirements of	MIL-STD-810 method 516, proced. V	
* Salt Atmosphere		MIL-T-28800C par. 3.9.8.1 tested, par. 4.5.6.2.1.
Structural parts meet requirements of	MILT-STD-810 methode 509, proced. I salt solution 20%	
* EMI (Electronic Magnetic Interference)		
meets requirements of	MIL-STD-461 CLASS B	Applicable requirements of part 7 : CE03, CS01, CS02, CS06, RE02, RS03
	VDE 0871 and VDE 0875 Grenzwertklasse B	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Magnetic Radiated Susceptibility Maximum Deflection Factor		Tested in conformity with IEC 351-1 par. 5.1.3.1. Measured with instrument in a homogeneous magnetic field (in any direction with respect to instrument) with a flux intensity (p-p value) of 1,42 mT (14,2 gauss) and of symmetrical sine-wave form with a frequency of 45...66Hz.

2.8 SAFETY

* Meets requirements of	IEC 348 CLASS I VDE 0411	Except for power cord, unless shipped with Universal European power plug.
	UL 1244 CSA 556 B	Except for power cord, unless shipped with North American power plug.
* Max. X-Radiation		Measured @ 5 cm from surface of instrument for a target area of 10 cm^2
* Recovery time	15 min.	$-10^{o}C$ ——> + $25^{o}C$ ambient temp.
	30 min.	$-20^{o}C$ ——> + $25^{o}C$ ambient temp.
	45 min.	$-30^{o}C$ ——> + $25^{o}C$ ambient temp.
	60 min.	$-40^{o}C$ ——> + $40^{o}C$ ambient temp.

3. INTRODUCTION TO CIRCUIT DESCRIPTION AND BLOCK DIAGRAM DESCRIPTION

3.1 INTRODUCTION TO CIRCUIT DESCRIPTION

The functioning of the circuits is described per printed-circuit board (p.c.b.). For every p.c.b. a separate chapter (4-10) is available containing the lay out of the p.c.b., the associated circuit diagram(s) and the circuit description.

Location of electrical parts

The item numbers of C...., R...., V...., N...., D.... and K.... have been divided into groups which relate to the circuit and the printed-circuit board according to the following table:

Item number	unit no.	Printed-circuit board	Figure
1000-1999	A1	Attenuator unit	4
2000-2999	A2	Pre-amplifier unit	5
3000-3999	A3	XYZ amplifier unit	6
4000-4999	A4	Time-base unit	7
5000-5999	A5	CRT control unit	8
6000-6999	A6	Power supply	9
7000-7999	A7	Front unit	10
8000-8999	A8	LCD unit	10

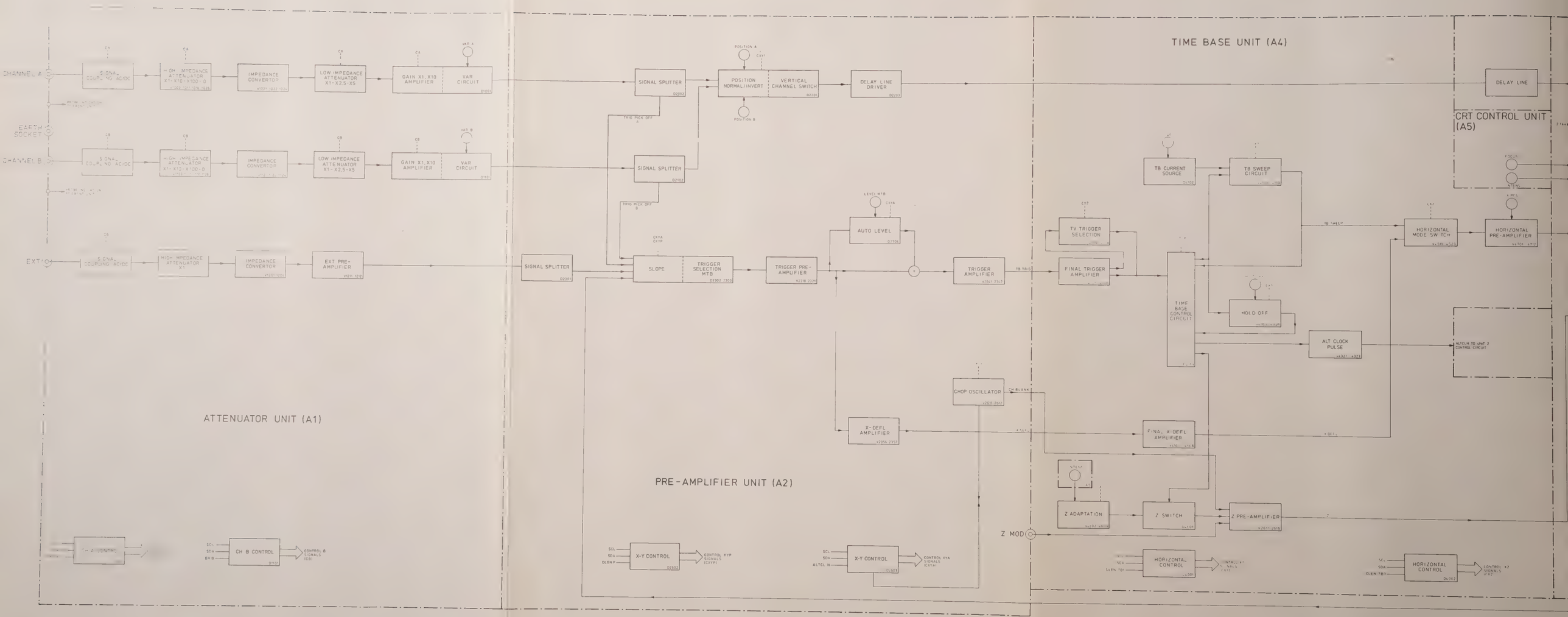
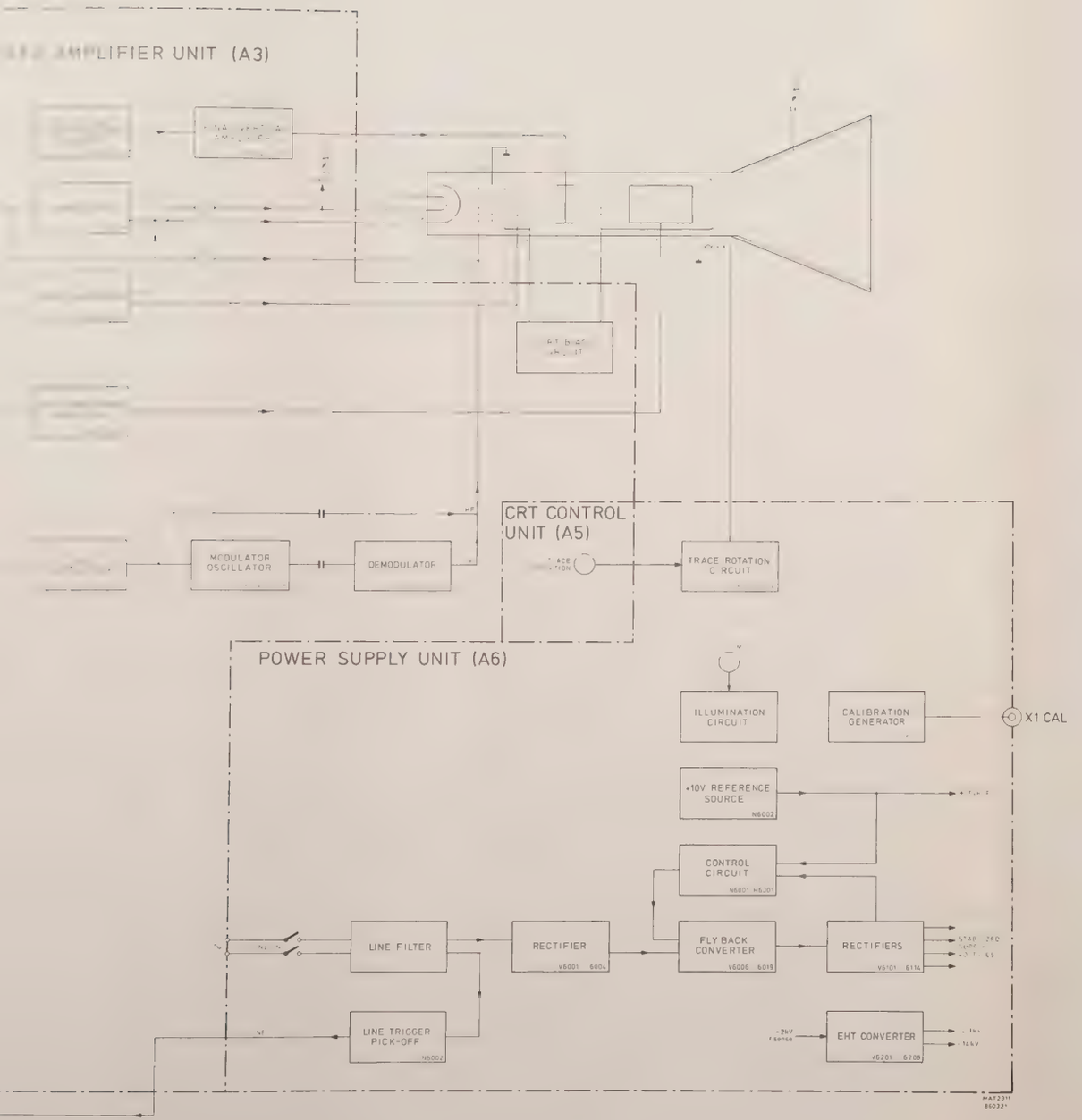


Figure 3.1 Block diagram



3.2 BLOCK DIAGRAM DESCRIPTION (see figure 3.1).

3.2.1 Introduction

This block diagram description is based around all the important functional blocks and their interconnections. The interconnections between all p.c.b.'s are given in the interconnection diagram of figure 14.5. In order to assist in cross-reference with the circuit diagrams, the blocks include the item numbers of the active components they contain.
Furthermore, the blocks are grouped together per printed-circuit board, or a part of it. To facilitate reference, the names of the functional blocks are given in text in CAPITALS.
Signal waveforms are also indicated at block interconnections where useful.
In this instrument almost all the switches (UP-DOWN controls, softkeys and potentiometer UNCAL switches) influence the oscilloscope circuits via a microcomputer (uC) system.

3.2.2 Control unit

Because the functional description of the control unit (see chapter 10) is almost simular to the blockdiagram description, no specific attention is given in this chapter to this unit.

3.2.3 Attenuator unit

The vertical channels A and B for the signals to be displayed are identical. Each channel comprises an input SIGNAL COUPLING for AC/DC, a HIGH IMPEDANCE ATTENUATOR which gives signal attenuation of x1-x10 or x100, an IMPEDANCE CONVERTER, a LOW IMPEDANCE ATTENUATOR which gives signal attenuation of x1-x2,5 or x5 and a GAIN x1-x10 AMPLIFIER block, incorporated with the CONTINUOUS CIRCUIT. This block has a variable gain, influenced by the front-panel VAR control. The gain is also increased by x10 in order to obtain 2-5 and 10mV settings.

Similar to the vertical channels, the external channel attenuator also has an input SIGNAL COUPLING, HIGH IMPEDANCE ATTENUATOR and IMPEDANCE CONVERTER in line. However, the external channel has only x1 attenuation and no LOW IMPEDANCE ATTENUATOR. The output of the external channel is fed to the EXT PRE-AMPLIFIER.

All blocks that are capable of working in different modes are controlled by the control A or control B signals. These signals are generated by the CH.A CONTROL or CH.B CONTROL blocks.

3.2.4 Pre-amplifier unit

This unit incorporates the signal splitters for the vertical channels A and B, the trigger view pre-amplifier, the trigger circuits for the time base and the chopper oscillator circuit. All these functions are controlled by the control XYP and control XYA signals, generated by the X-Y CONTROL blocks.

* Vertical channels A and B:

Both channels are completely identical and receive their input signals from the ATTENUATOR UNIT. This signal is applied to the SIGNAL SPLITTER, which has two outputs:

- one output applied to the SLOPE/TRIGGER SELECTION for time base triggering.
- a second output routed to the POSITION/NORMAL-INVERT block.

This block is incorporated with the VERTICAL CHANNEL SWITCH in a single IC. Vertical shift of the displayed signal is achieved by the front-panel POSITION control. The output of this block is routed via the DELAY LINE DRIVER to the DELAY LINE.

* Trigger circuit:

The SLOPE/TRIGGER SELECTION block receives a trigger signal from one of the vertical channels A or B, from the EXT SIGNAL SPLITTER or from the LINE TRIGGER PICK-OFF.
Inverting of the trigger signal is controlled by the CXYA signals INVAM and INVBM to obtain the slope function.
Routed via the TRIGGER PRE-AMPLIFIER, block the signal is split up into different paths:

- after summation of the LEVEL signal, direct to the TRIGGER AMPLIFIER
- to the AUTO LEVEL block. This block contains the different trigger facilities and levelling of the trigger signal is influenced by the front-panel LEVEL control. The output of this path is routed again to the summation point to influence the direct trigger signal.
- to the X-DEFL AMPLIFIER for X-deflection facility. This block incorporates a phase correction circuit for the X-Y display.

The TRIGGER AMPLIFIER feeds the trigger signal to the time-base unit.

* Chopper oscillator circuit:

A square-wave signal for chopper blanking and vertical switching is generated in the CHOP OSCILLATOR. For chopper blanking the signal is routed to the Z PRE-AMPLIFIER on the time-base unit.

3.2.5 Time-base unit

This unit incorporates the time-base (TB), the horizontal amplifier and the Z amplifier circuit. All functions are controlled by the CX1 and CX2 signals, generated by the HORIZONTAL CONTROL CIRCUIT blocks.

* Time-base (TB):

The trigger signal can be either directly routed to the TIME-BASE CONTROL CIRCUIT or first routed via the TV TRIGGER SELECTION for the TV trigger coupling. When in the AUTO mode, in the absence of trigger signals, the time base will be free running.

The CURRENT SOURCE applies the sawtooth charging current to the sweep circuit. This block generates the sawtooth signal, which is routed to the HORIZONTAL DISPLAY MODE SWITCH..

The HOLD OFF and the ALT CLOCK PULSE blocks are also under control of the TIME BASE CONTROL CIRCUIT. Hold off time is varied by the front-panel HOLD OFF control. The output of the HOLD OFF block is routed to the TIME-BASE CONTROL CIRCUIT again.

The ALTCLN-pulse is applied to the PRE-AMPLIFIER UNIT.

3.2.6 XYZ unit

This unit comprises the final amplifiers for the vertical (Y) and horizontal (X) deflection and for the blanking (Z) circuit. In addition to this, the CRT control circuits are also incorporated in the unit.

* Final vertical amplifier:

The output signal from the pre-amplifier unit is first routed via the DELAY LINE to give sufficient delay to ensure that the steep leading edges of fast signals are displayed and then fed to the DELAY LINE COMPENSATION. This block compensates the signal for distortion originating in the DELAY LINE before it is applied to the FINAL VERTICAL AMPLIFIER. The output of the FINAL VERTICAL AMPLIFIER feeds the vertical deflection plates of the CRT.

* Final horizontal amplifier:

The horizontal deflection signal is routed to the FINAL HORIZONTAL AMPLIFIER, the output of which feeds the horizontal deflection plates of the CRT.

* Blanking circuit:

The output signal from the Z PRE-AMPLIFIER of the time-base unit, that determines trace blanking or unblanking and modulation is routed to the FINAL Z-AMPLIFIER. After amplification the blanking signal is split into two paths:

- the h.f. signals are fed via a high voltage capacitor to grid G1 of the CRT.
- the l.f. signals are used to modulate the amplitude of an oscillator wave-form, which then passes via another high voltage capacitor and is demodulated in the DEMODULATOR block to retrieve the original signal.

Note that the original h.f. and l.f. signals are again recombined on the grid G1.

* CRT control circuits:

The FOCUS AMPLIFIER block is influenced by both front-panel FOCUS and INTENS controls to provide a focus that is independent of the intensity, and drives the focusing grid G3 of the CRT.

The -100 V BLACK LEVEL block provides the correct presetting of the cathode voltage.

The CRT BIAS gives a d.c. voltage to the grids G4 and G5 to provide an optional adjustment for geometry and astigmatism.

3.2.7 Power supply unit

The mains input voltage is filtered and then applied to the RECTIFIER block to obtain a d.c. voltage source. Another output of the LINE FILTER block is routed via the LINE TRIGGER PICK-OFF and serves as a LINE trigger signal. The rectified mains source is routed to the FLYBACK CONVERTER, which generates the necessary voltages for the oscilloscope circuits. Each supply voltage is rectified in the RECTIFIERS block.
The LOW-voltage supplies are stabilized by the CONTROL circuit to the converter.
The +10 V REF supply serves as a low-voltage reference and is generated in the +10 V REFERENCE source block. This reference voltage is also fed to the different circuits on the power supply or in the oscilloscope.

The EHT CONVERTER generates the -14 kV for the post-accelerator anode of the CRT and the -2 kV for the cathode circuits.

* Auxiliary circuits:

The CALIBRATION GENERATOR generates the CAL voltage, which is applied to the output socket X1. The CAL voltage has a 1,2 V p-p level with a frequency of 2kHz square wave.

The ILLUMINATION CIRCUIT determines the amount of current passed to the graticule illumination lamp of the CRT controlled by the ILLUM control on the front-panel.

The TRACE ROTATION CIRCUIT determines the strength and sense of the current passed to the trace rotation coil around the neck of the CRT. The current is influenced by the front-panel screwdriver operated TRACE ROT control.

4. ATTENUATOR UNIT (A1)

4.1 VERTICAL ATTENUATORS

The A and B channel attenuators are identical: therefore only channel A is described.

All relay and FET switches are controlled by the microcomputer via the I^2C bus. The TEA 1017 converts this serial DATA into the parallel control signals for all relay or FET switches. A list of the control lines for all attenuator settings is given in the table below.

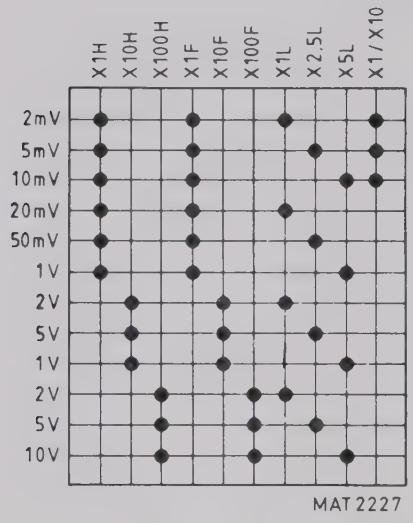


Figure 4.1 Table of attenuator settings

The channel A attenuator consists of in five stages:

Input coupling, where depending on the relay K1001 position, the input signal can either be d.c.-coupled (relay activated) or a.c.-coupled (relay not activated).

High impedance attenuator with three attenuator stages for the x1, x10 and x100 attenuation. The l.f. part of each stage is split via a resistor divider and routed via N1001 and V1019 to the output of this stage, where it is re-connected with the h.f. part of the input signal. Potentiometers R1036 (TRACE jump) serves as a offset compensation for N1001.

	RELAY	FET	TRIMMER FOR L.F. SQUARE WAVE	L.F. RESISTOR DIVIDER
x 1	K1004	V1011	C1033	--
x 10	K1003	V1006	C1029	R1007-R1011
x100	K1002	V1003	C1023	R1019-R1004

Note that, when "0" (GND-A) is selected, the output is connected to ground via FET V1016 and all other relay- and FET switches are switched off.

The impedance converter serves as an inverting buffer circuit for the high impedance attenuator. For the l.f.-feedback the output signal of this stage is routed to the l.f. summation point N1001-2.

The low impedance attenuator reduces the gain by x1, x2.5 and x5, depending on which relay is activated.

	RELAY	RESISTOR DIVIDER
x1	K1006	--
x2.5	K1007	R1053 vs R1056, R1057 and R1058
x5	K1008	R1053, R1056 and R1057 vs R1058

The continuous circuit (OQ0203), the differential input voltages of which are fed to pins 4 and 5.
This stage comprises the following functions:

- Continuously variable control (pin 11).
- Gain x1 (pin 2 and 3) with offset adjustment R1064 (R1164) and gain adjustment R1069 (R1169).
- Gain x10 (pin 6 and 7) with offset adjusting R1072 (R1172) and gain adjustment R1076 (R1176).
- x1/x10 control to select the 2,5 and 10 mV/DIV settings.

The differential output current from pin 13 and pin 14 is routed via a common-base circuit V1063, V1064 and applied to the pre-amplifier unit.

4.2 EXTERNAL INPUT

The external input can be subdivided into four stages:

Input coupling, basically similar to the ch.A input coupling.

High impedance attenuator for the x1 attenuator only, where the l.f. square-wave can be adjusted with trimmer C1206. The l.f. part is routed to the summation point N1201-2. R1217 serves as an offset compensation for N1201. For l.f.-feedback the output of the impedance converter is also routed to this summation point.
Note that the output of this stage is also a reconstituted version of the input signal.

Impedance converter, is basic similar to the ch.A impedance converter.

The differential amplifier V1211, V1212 converts the voltage from emitter-follower V1209 into the differential current signals EXT+ and EXT-. This signal is applied to the pre-amplifier unit and serves as external trigger signal or as an external deflection signal.
The current for this stage is applied from current source V1213.

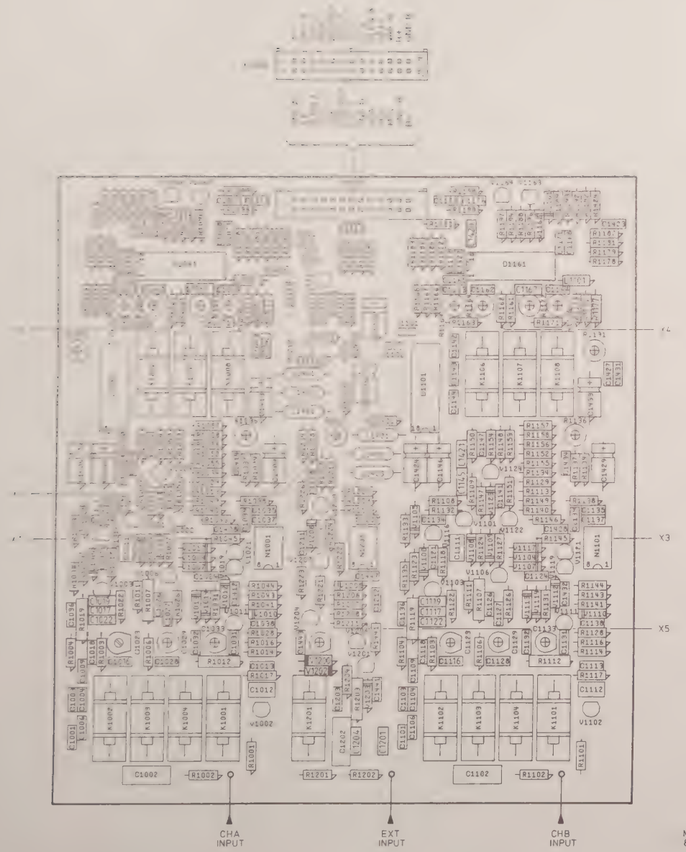


Figure 4.2 Attenuator unit p.c.b.

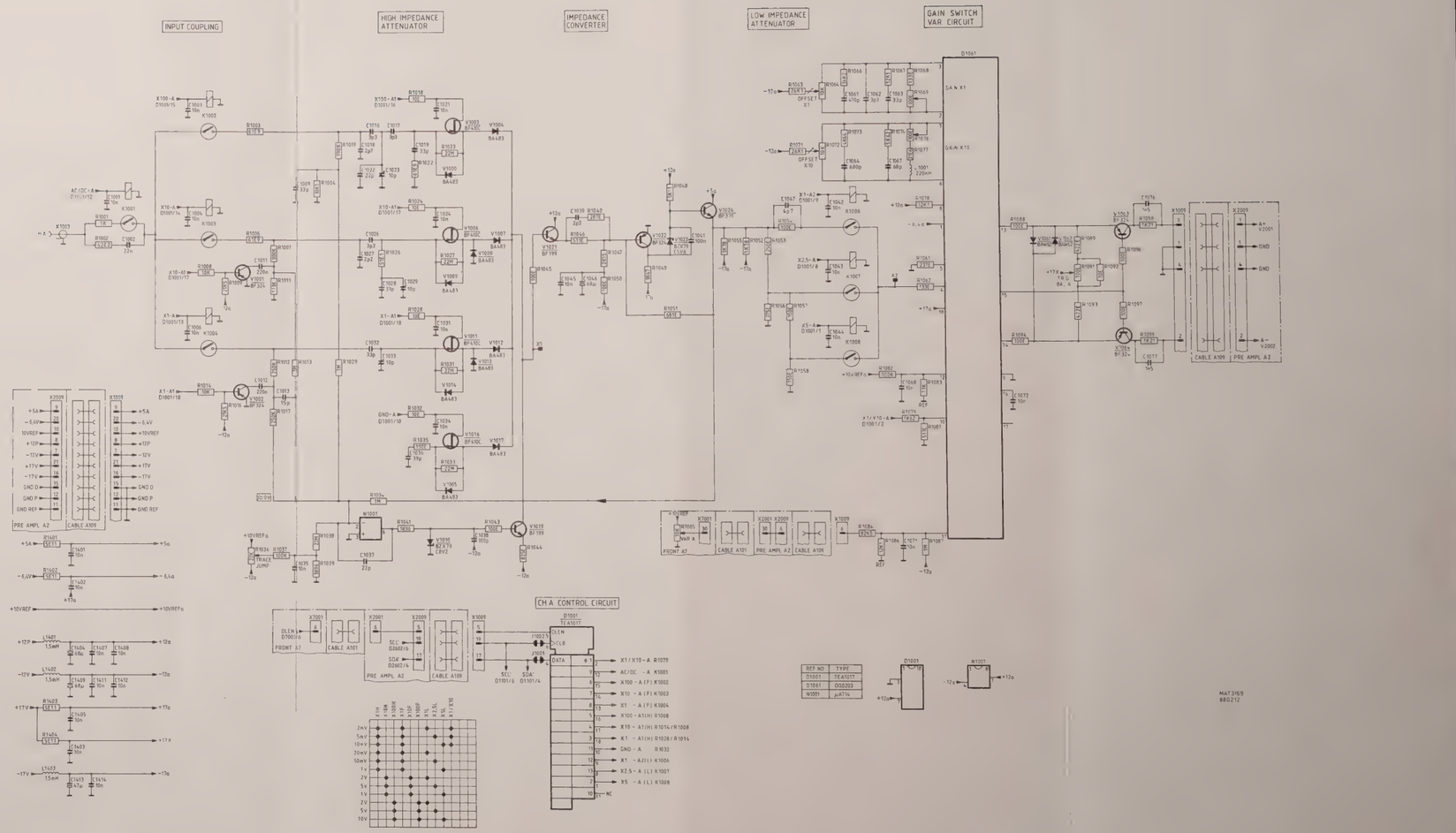


Figure 4.3 Circuit diagram of attenuator, ch. A

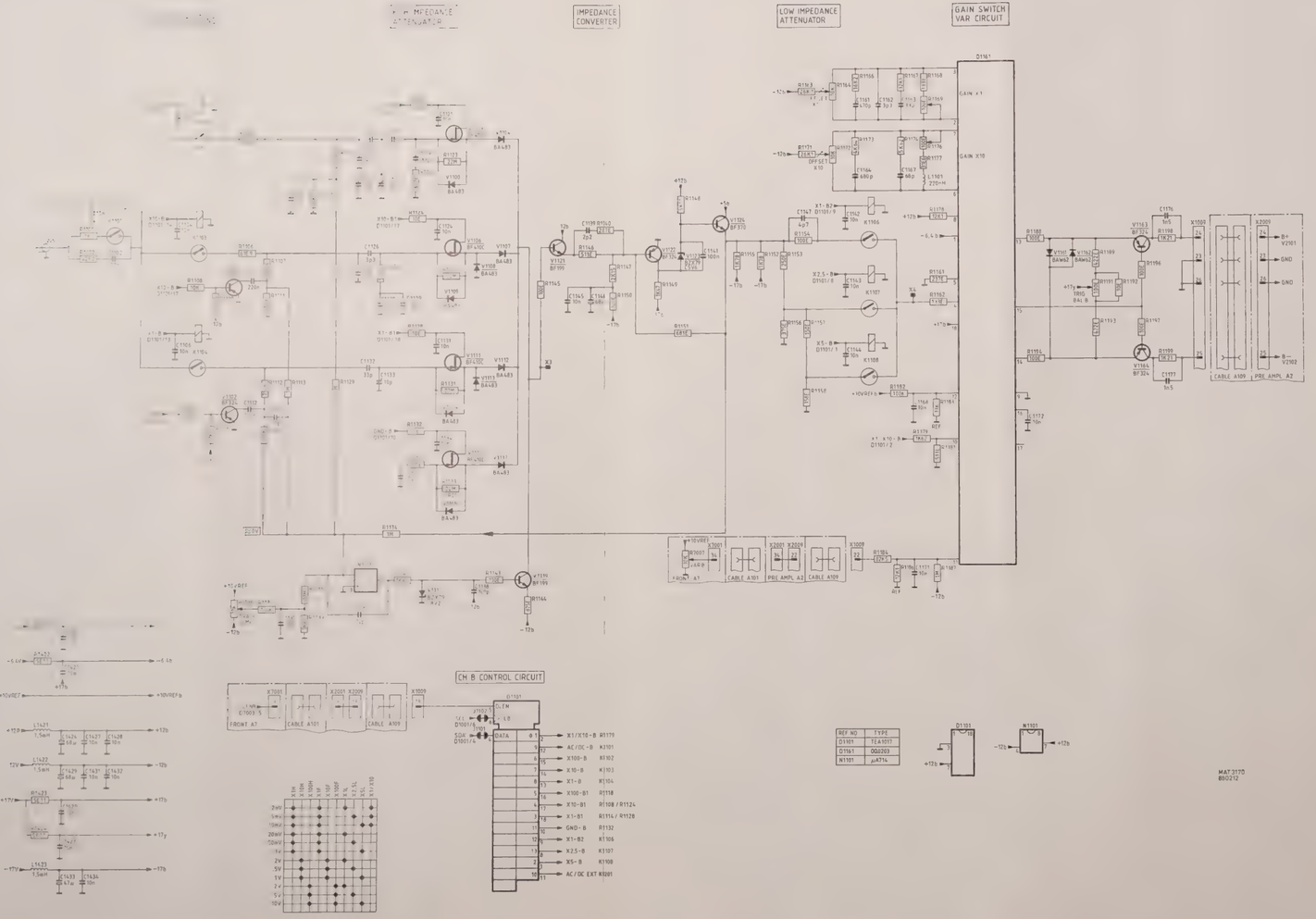


Figure 4.4 Circuit diagram of attenuator, ch. B

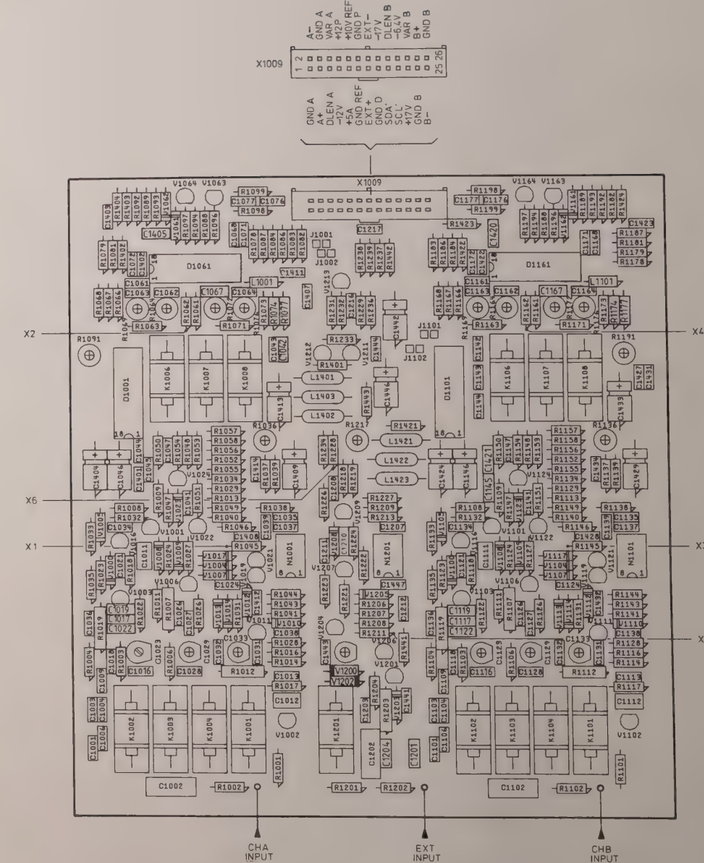


Figure 4.5 Attenuator unit p.c.b.

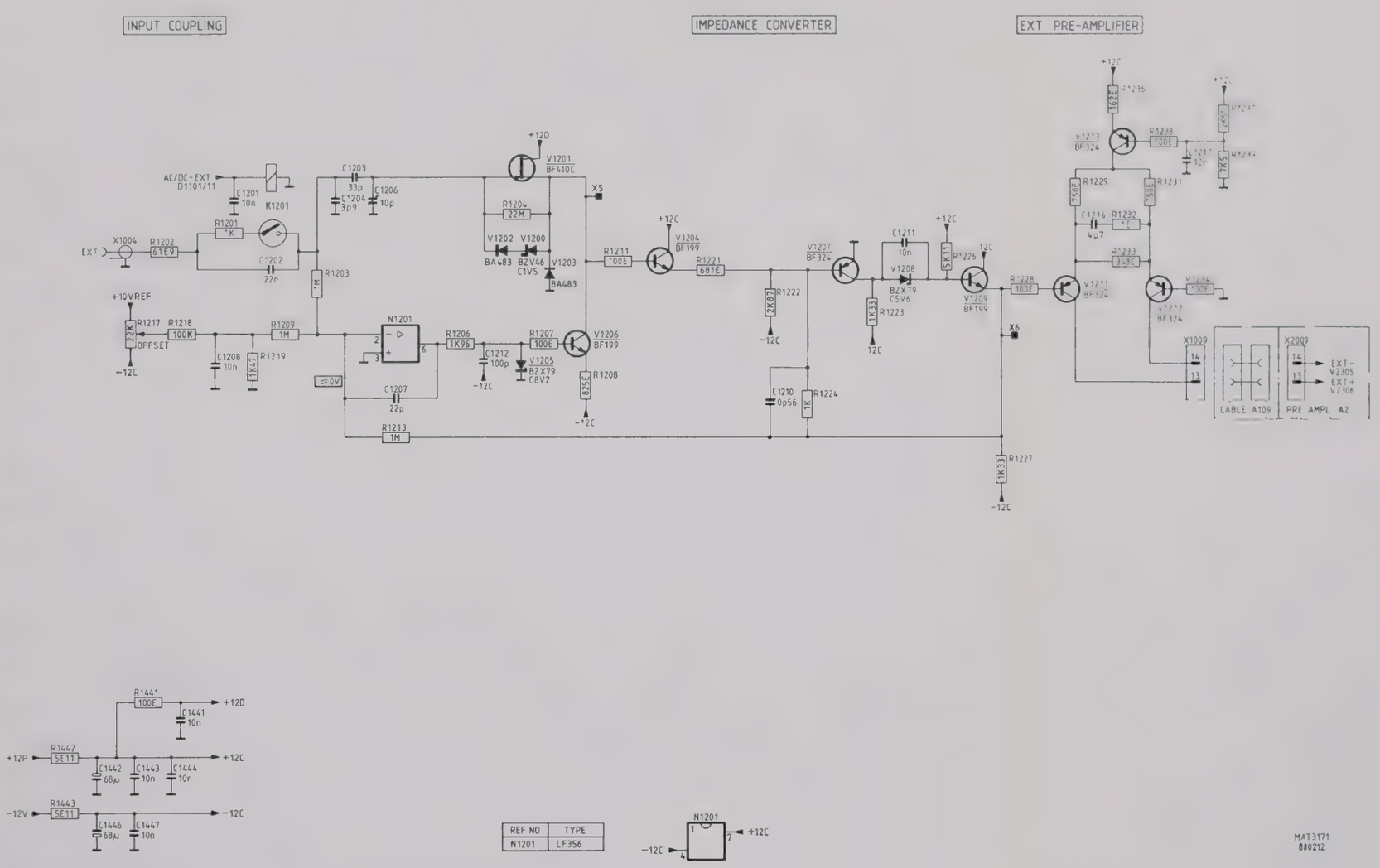


Figure 4.6 Circuit diagram of attenuator, EXT

5. PRE-AMPLIFIER UNIT (A2)

The pre-amplifier unit consists of:

- Vertical pre-amplifier
- Trigger pre-amplifier
- Pre-amplifier control, incl. CHOPPER oscillator.

All control pulses for this unit are generated by the pre-amplifier control circuit, via the I^2C bus (see section 5.4).

5.1 VERTICAL PRE-AMPLIFIER

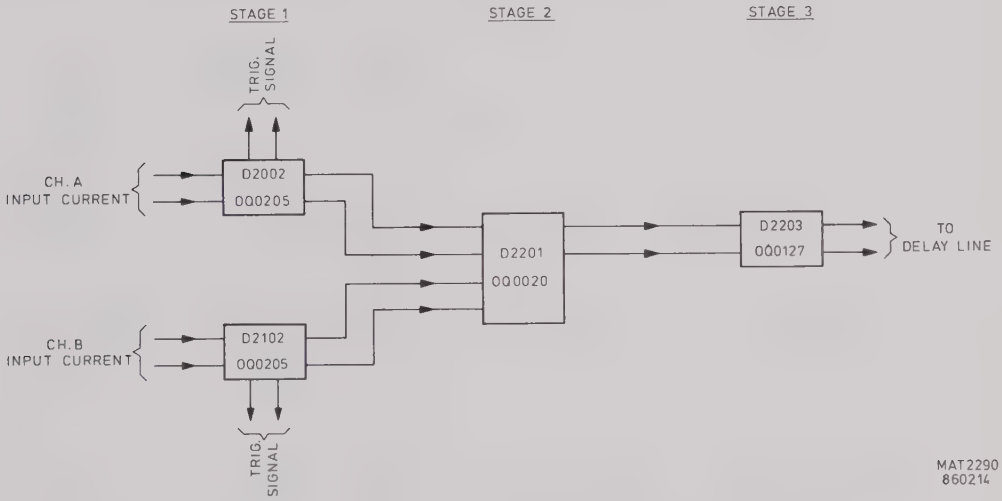


Figure 5.1 The three stages of the vertical pre-amplifier

The vertical pre-amplifier consists of three stages.

The signal splitter (Q0205) receives its input signal for channel A (B) from the attenuator unit and copies this signal into two identical differential output current signals for:

- Vertical channel (pin 7 and 10).
- TB triggering (pin 5 and 12), see section 5.2.

Stage 2 (QQ0020) consists of two integrated circuits D2201 and D2202, connected in parallel and serves as a vertical channel switch. The switch selection is as follows:

	D2201		D2202
	pin 10	pin 11	pin 10
A	1	0	0
B	0	1	0
ADD	1	1	0

Further, all possible 2, 3, or 4 channel combinations are possible in alternated or chopped display (see also section 5.4).

This stage comprises the following functions:

- Position control POS A R7006 on D2201-1 for ch. A and POS B R7008 on D2201-8 for ch. B.
- Channel B normal/invert (high is INVERT) on D2201-7. (The balance between normal/invert can be adjusted with R2212).

Stage 3 (D2203) serves as delay line driver where the output current of both OQ0020 is converted into voltage signal applied to the delay line. The current for this stage and for D2201 and D2202 is fed via R2231 and R2246.
The current regulation for the common-mode circuit is achieved by transistor D2203 (12, 13, 14).

5.2 TB TRIGGER PRE-AMPLIFIER

Trigger possibilities are:

	Signal name	routed to	Selected by: name	routed to	inverted by: name	routed to
ch. A	TRAM+, TRAM-	D2302(3,4)	AM	D2302(10)	INVAM	D2302(2)
ch. B	TRBM+, TRBM-	D2302(5,6)	BM	D2302(11)	INVBM	D2302(7)
EXTERNAL	EXT-, EXT+	D2303(3,4)	EXTM	D2303(10)	INVAM	D2303(2)
line	LINE	D2303(5)	LNM	D2303(11)	INVAM	D2303(7)

D2301 serves as a signal splitter and receives its input signal from the attenuator unit. This input current signal is copied into a identical differential output current signals for EXT MTB signal (pin 6 and 11).

The symmetrical output currents from D2302 (13, 14) and D2303 (13, 14) are converted into a symmetrical voltage again in the common-base circuit V2316, V2319 followed by a shunt feedback circuit V2318 and V2321. Note that the sensitivity at the collectors of V2318 and V2321 is 110 mV/DIV.

At this point the signal path is divided into:

- a trigger path, fed to both V2333 and V2334, where depending on the current to the base, levelling of the trigger signal is obtained. Two separate series feedback circuits take care of voltage-to-current conversion:
  * V2341 and V2342 for time-base triggering.
    The trigger output signal, TRIGM- and TRIGM+ are fed to the time-base unit A4.

Integrated circuit D2304 serves as an auto level circuit.
The following functions are possible.

a. Peak-peak

In this case the amplitude of the trigger signal applied to D2304 (3,7) is measured by peak-peak detectors on D2304 (2,4,6,8).
The output current from D2304 (14,15) is dependent on the peak-peak level and is adjustable with the LEVEL control R7012, connected to D2304(1).

b. Triggering

In this case the level range is 16 div. The level is adjustable with R7012 and the current variation on D2304 (14,15) can be varied between +or- 0,6mA.

c. TV triggering

The level control is made ineffective. In TV triggering, the LEVEL must be set to a fixed value. This is done by applying a high level current to pin 1 via diode V2326.

d. Auto

In auto the signal LEVEL ZERO is high and via diode V2325 the output level D2304 (15) is asymmetrical with output level D2304 (14) Thus the maximum signal amplitude is 2 Vp-p.

- an external deflection path, routed via the series feedback circuit V2356 and V2357, the X DEFL+ and X DEFL- signals are fed to the time base unit A2.
  R2416, R2422 and C2350 gives phase correction for the X-Y display.

5.3 PRE-AMPLIFIER CONTROL

The pre-amplifier control converts the data from the I^2C bus (SDA and SCL), derived from the microcomputer, into the control pulses for the pre-amplifier unit. To eliminate interference the SDA and SCL lines can be switched off via D2601.

This integrated circuit serves as a digital switch, controlled by the VERT IIC line. Logic high connects the outputs D2601(4,14,15) to the input "1" contact (switched on); logic low connects the outputs to the "2" contact (switched off) and gives SDA a logic low level and SCL a logic high level.

When D2601 is switched on, the serial data information is converted into parallel control pulses via D2602 and D2603, provided that D2602 is enabled (D2602-5 is high). The control lines are active when the level of the line is high.

Output Q12-D2602(9) serves as a power up not line for D2603: when the oscilloscope is in the power-up routine, Q12 is high and resets D2603. After the power-up routine, Q12 goes low and enables D2603.

Integrated circuit D2603 relieves the microcomputer of a number of such functions as:

- chop/alt
- trigger select
- time-base select (fed to time base unit A4)

Adaptation of this I.C. to the oscilloscope version is made by the AD0 and AD1 inputs D2603(15,16).
For this oscilloscope, AD0 must be HIGH and AD1 must be LOW.

Timing for alternate and chopped mode is derived by the ALTCLN and CHOPCL pulses.

The chopper oscillator formed by V2611 and V2612 supplies a square wave voltage of 1,5 Vp-p with a frequency of 1 MHz.

This frequency is defined by two current loops:

- I1 is determined by: V2612(c-e), C2611, R2627 and R2625.
- I2 is determined by: V2611(c-e), C2611, R2628 and R2625.

The duty cycle (I1/I1+I2) is 12% approx.

The square wave on the collector of V2612 serves as a chopper clock pulse for D2603 and gives a 500 kHz display for 2 channels CHOP, 333 kHz display for 3 channels CHOP and 250 kHz for 4 channels CHOP (A-B-TRIG VIEW-ADD).

Note that D2603(8) serves as the chopper switch, which is high when the CHOP softkey is depressed.

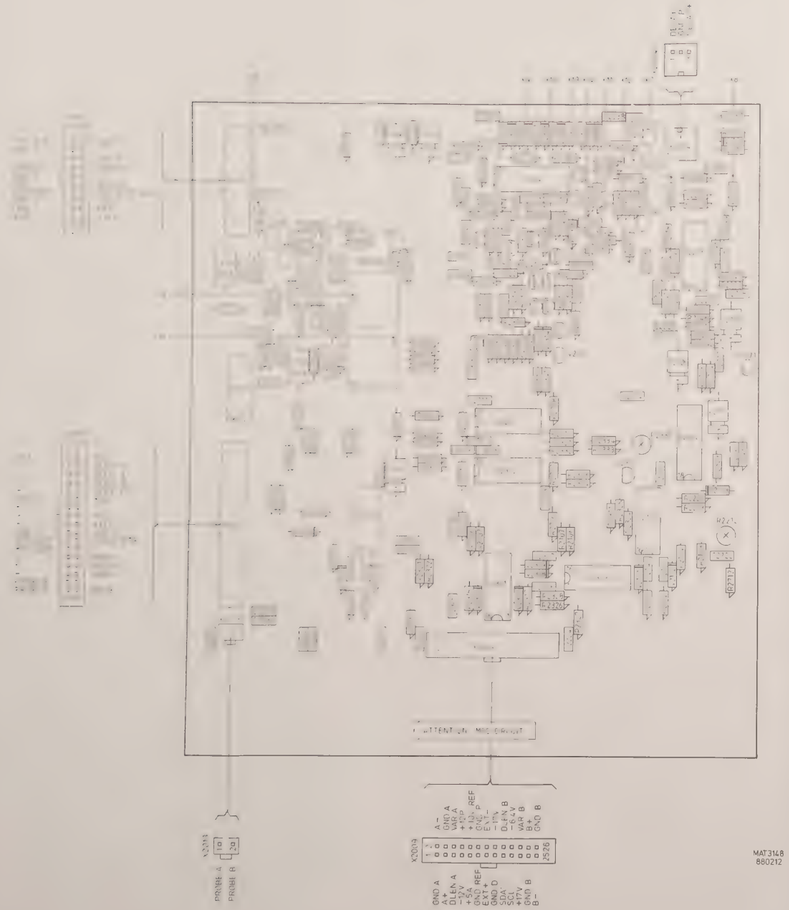


Figure 5.2 Pre-amplifier unit p.c.b.

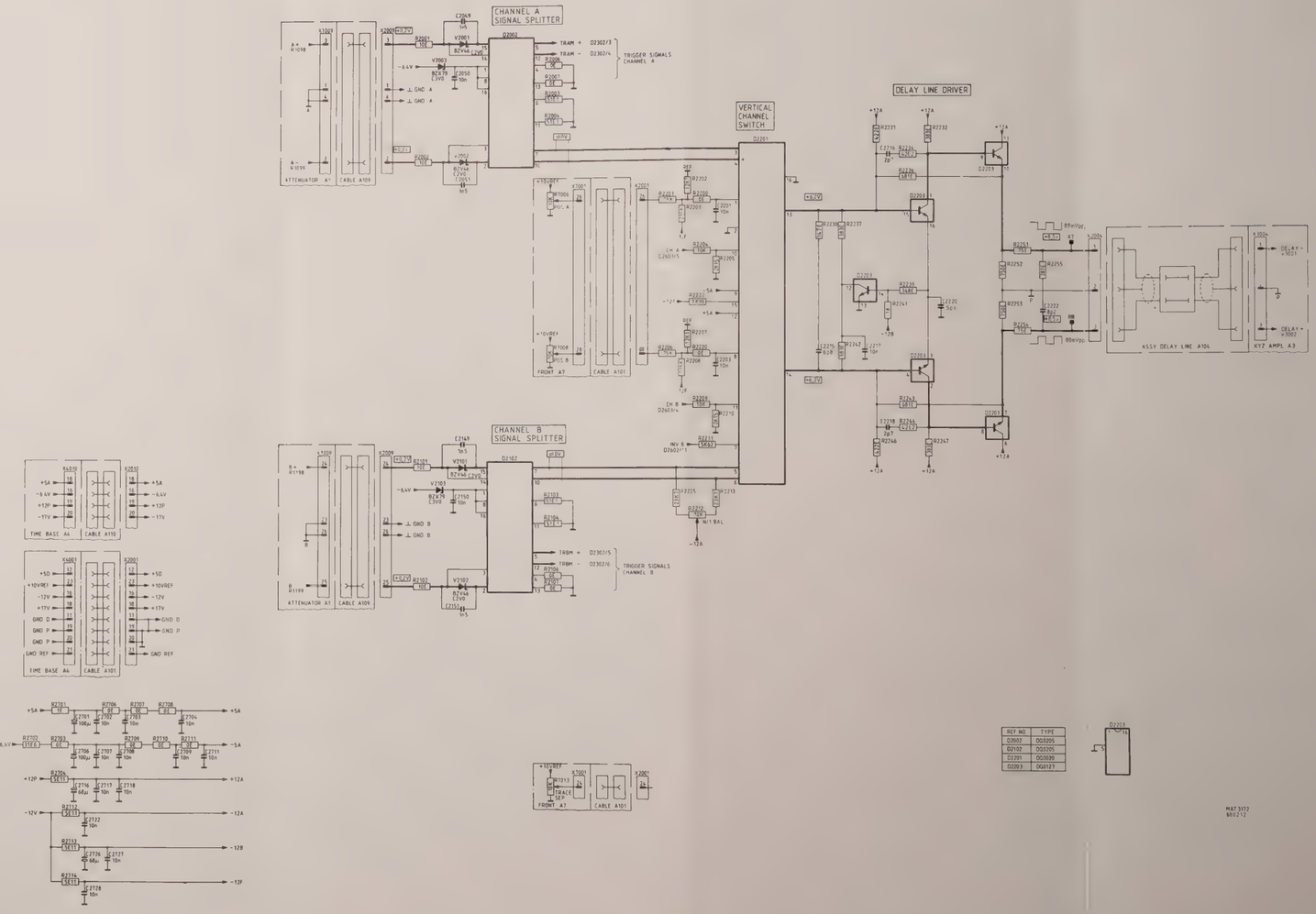
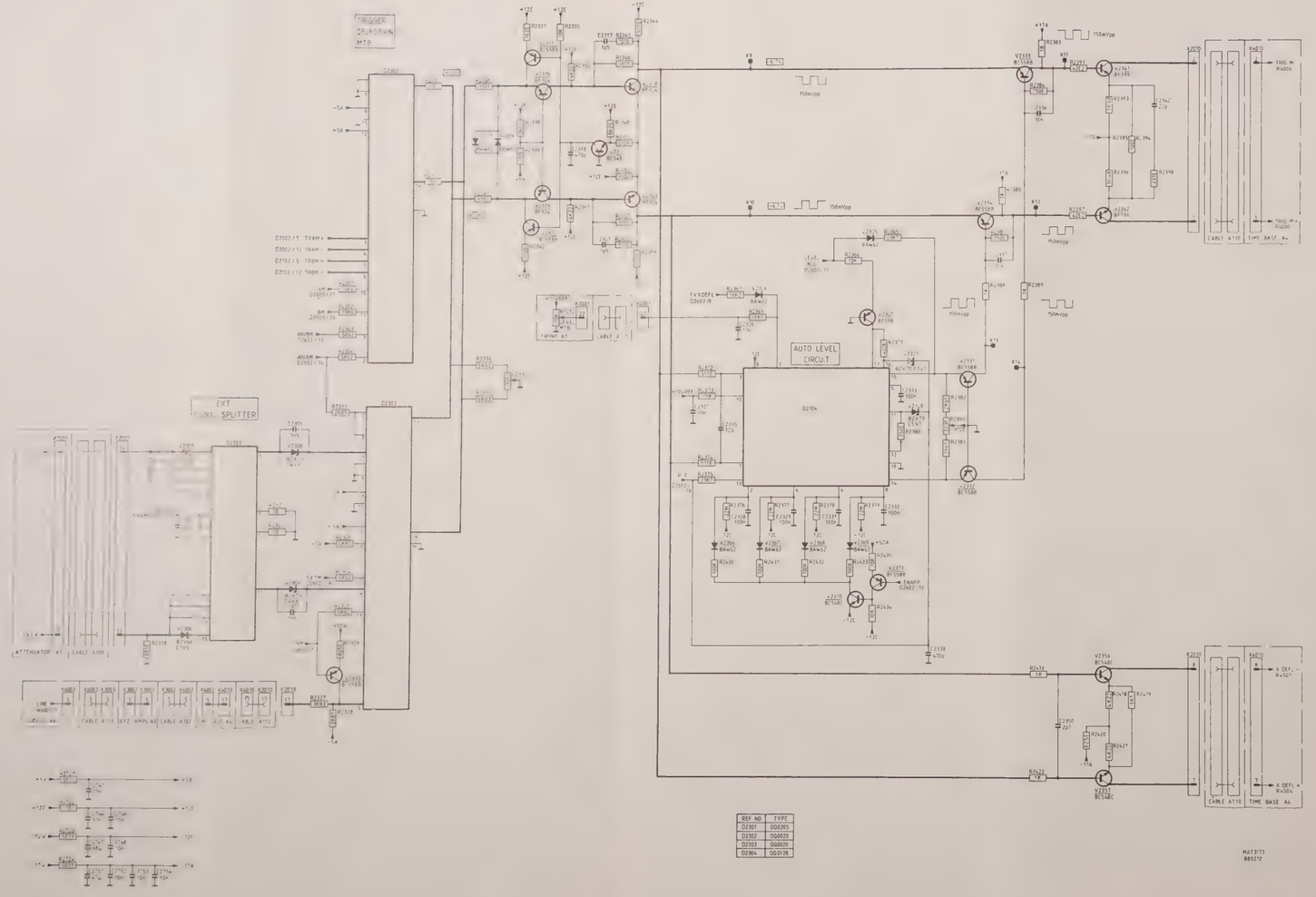


Figure 5.3 Circuit diagram of pre-amplifier, channel switch + delay line driver



REF NO	TYPE
D2301	DG0305
D2302	DG0020
D2303	DG0020
D2304	DG3128

Figure 5.4 Circuit diagram of pre-amplifier, trigger switch

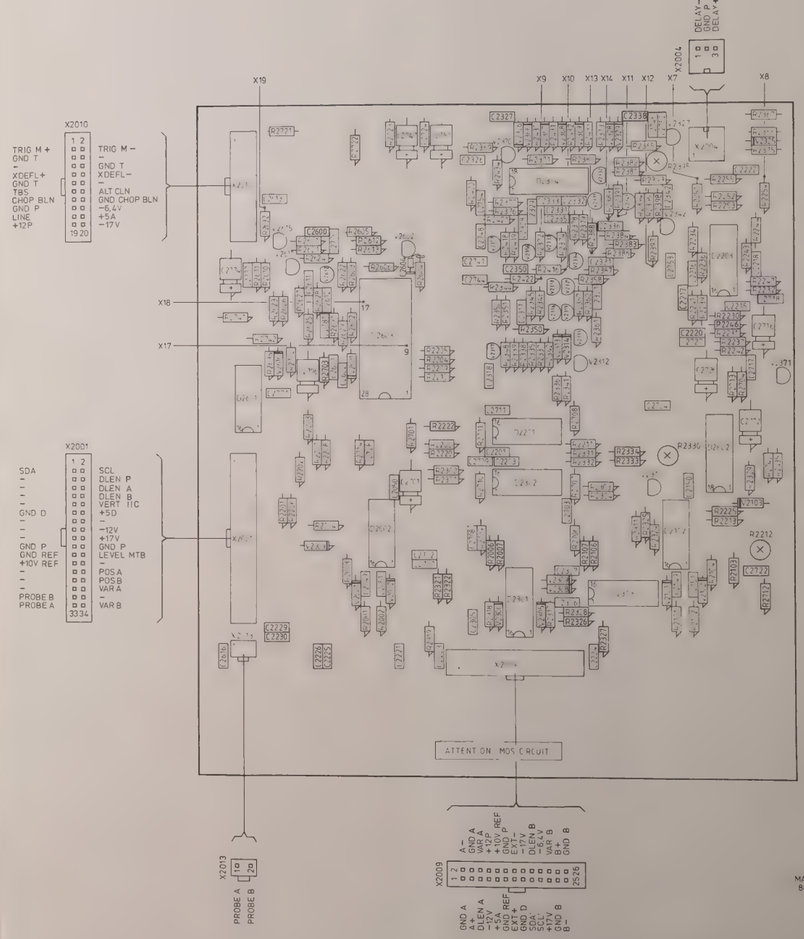
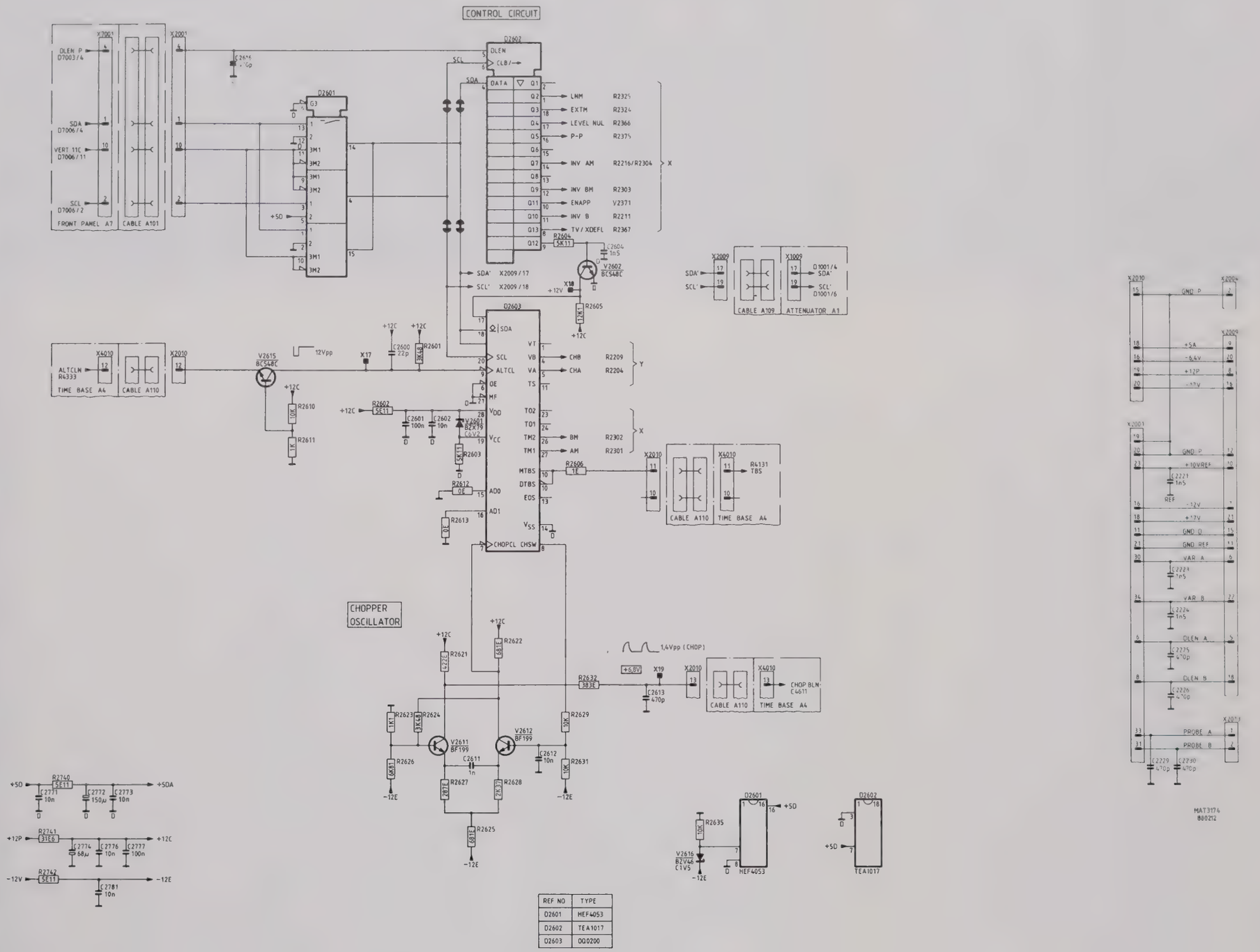


Figure 5.5 Pre-amplifier unit p.c.b.



REF NO	TYPE
D2601	HEF4053
D2602	TEA1017
D2603	00 0200

Figure 5.6 Circuit diagram of pre-amplifier, logic control

6. XYZ-AMPLIFIER UNIT (A3)

6.1 INTRODUCTION

Unit A3 incorporates two separate pcb's which are connected via A3001. One p.c.b. includes among other things the CRT socket and is connected at the rear of the CRT. The other p.c.b. comprising the proper final X and Z amplifiers is situated at the upper side of the CRT. For ease of description, unit A3 is described as one unit.

The XYZ-amplifier unit consists of:

- Final vertical (Y) amplifier.
- Final horizontal (X) amplifier.
- Final unblanking (Z) amplifier, incl. CRT.

6.2 FINAL VERTICAL (Y) AMPLIFIER

The final Y-amplifier receives its signal from the delay line and supplies the correct vertical signal to the Y-deflection plates of the CRT. For this the signal is processed in four stages:

- V3001, V3002 as a series feedback amplifier, including a delay line compensation network and potentiometer R3007 controlling current source V3003 for correction of any unbalance in the Y-deflection plates of the CRT. These circuits are connected between the emitters of both transistors.
  In this stage the input voltage is converted into a current signal.
- V3004, V3006 as a shunt feedback amplifier, which gives a voltage signal to the next stage.
- V3008, V3009 as a series feedback amplifier, including a final RC-correction network and potentiometer R3038 for gain adjustment to compensate the different CRT sensitivities. V3007 supplies a constant current of 60 mA, i.e. 30 mA for each side.
  Note that the output again supplies a current signal.
- V3011, V3012 as a common-base amplifier for buffering the final Y-amplifier to the Y-deflection plates. The maximum amplitude on each deflection plate is: 30 mA x 660 E = 20 V approx.

6.3 FINAL HORIZONTAL (X) AMPLIFIER

The input current for X-deflection is obtained from the time-base unit (ref: X- and X+) and processed in three stages, with circuits in the following configurations:

- V3101, V3102 as a common-base amplifier. The current "I" on the collector of both transistors determines the voltage across R3102 and R3116. This voltage is about 1,5 V p-p and feeds the next stage.
- V3103, V3106 as a series feedback amplifier, including a RC-correction network for optimum linearity of the trace and potentiometer R3118 for xl amplifier adjustment, mounted between the emitters of both transistors. V3104 serves as current source.

- V3112, V3114 are connected as a shunt feedback amplifier, with resistors R3126 and R3134 as the feedback resistors. The transistor source are emitter followers V3109, V3111. This circuit serves as the actual final amplifier, which converts the deflection current into the proper deflection voltage for the X-deflection plates of the CRT. Transistors V3108, V3116 supply the bias current for the circuit.

6.4 FINAL BLANKING (Z) AMPLIFIER AND CRT

The blanking current derived from the Z pre-amplifier of the time-base unit is routed via common base amplifier V3200 and emitter-follower V3201 to the shunt-feedback amplifier V3202. This stage is fed by current source V3203, which gives a constant current of 4 mA. The voltage on the collector of V3202 can vary between +5 V for unblanking and -35 V for fully blanking.
This Z-pulse may contain d.c., l.f. and h.f. components to be applied to grid G1 of the CRT. Since G1 is at a cathode potential of -2000 V, blocking capacitors are required between G1 and the Z-amplifier output. The h.f. component is directly routed via blocking capacitor C3211 to G1. However, the d.c. and l.f. components are blocked, so these components are first modulated on a 200 kHz carrier signal by V3207 and V3208 to pass blocking capacitor C3209. Then the signal is demodulated again by V3209 and V3211. Finally, the reconstituted d.c. and l.f. components are added to the h.f. component.

Transistor V3251 forms a nominal 70 V zener circuit which provides the voltage difference between the cathode and G1 of the CRT. This bias voltage ensures blanking when there is no input signal. For adaptation to each CRT, this voltage can be varied between about 40 V and 100 V by means of R3252 (BLACK LEVEL). Resistor R3254 maintains the filament at the same potential as the cathode.

Any ripple on the cathode voltage is fed-back via transistor V3213 to the input of the Final Z-amplifier and added to the blanking signal. This means that the differential voltage between G1 and the cathode of the CRT is always fixed. Because this differential voltage determines the intensity of the spot, as a result, the intensity is almost independent of the ripple.

The amplifier stage V3253, V3254 and V3256 provides amplification for the range of the FOCUS control. The range of 0...+10 V gives a final range on G3 of the CRT of -1350 V ... -1600 V.

Resistor R3257 connects the INTENS control to the focus adjustment to maintain a sharply defined trace at varying brightness.

For optimum presetting of the GEOMETRY, the voltage on G5 of the CRT is set to a fixed level of -30 V. The ASTIGMATISM can be varied by means of potentiometer R3267.

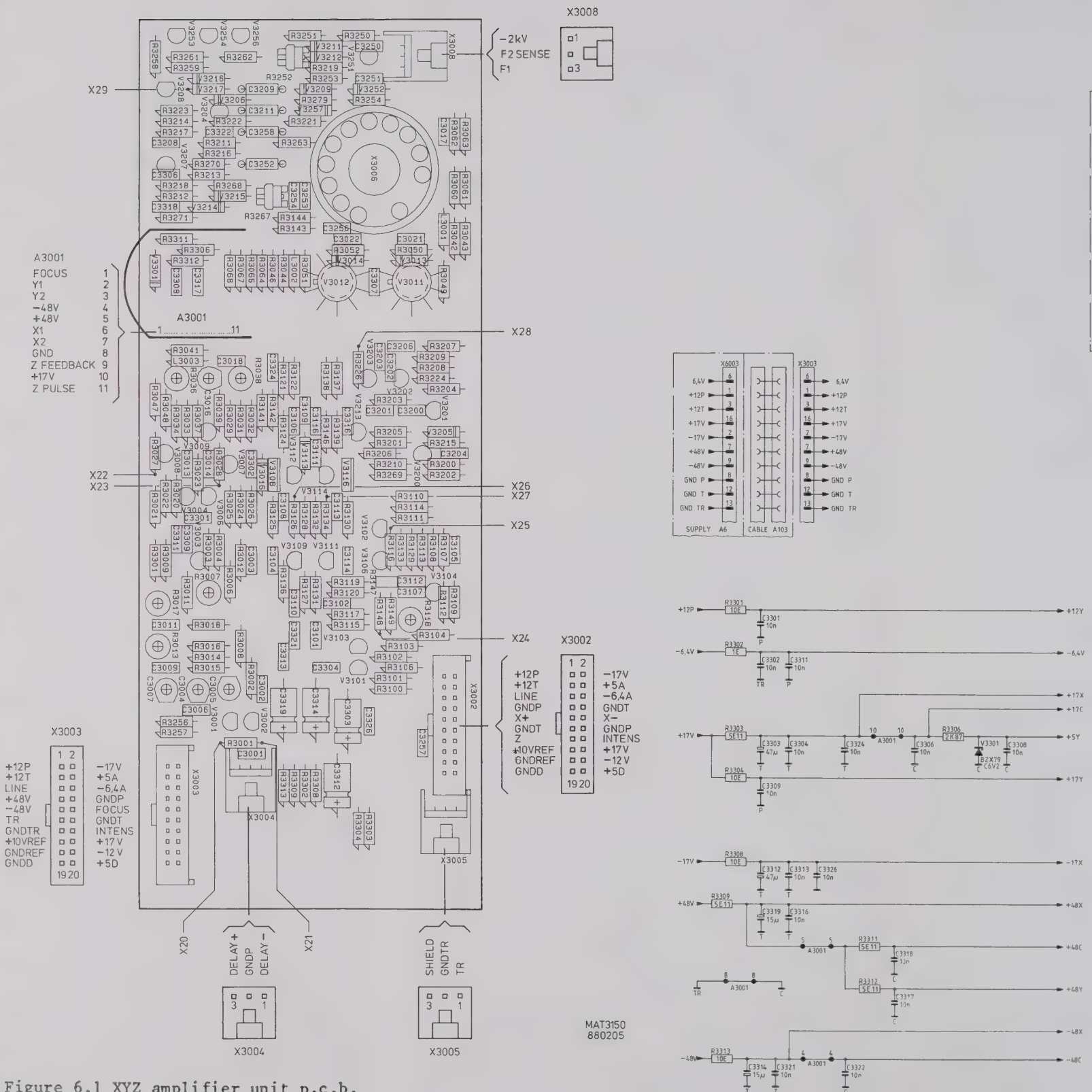


Figure 6.1 XYZ amplifier unit p.c.b.

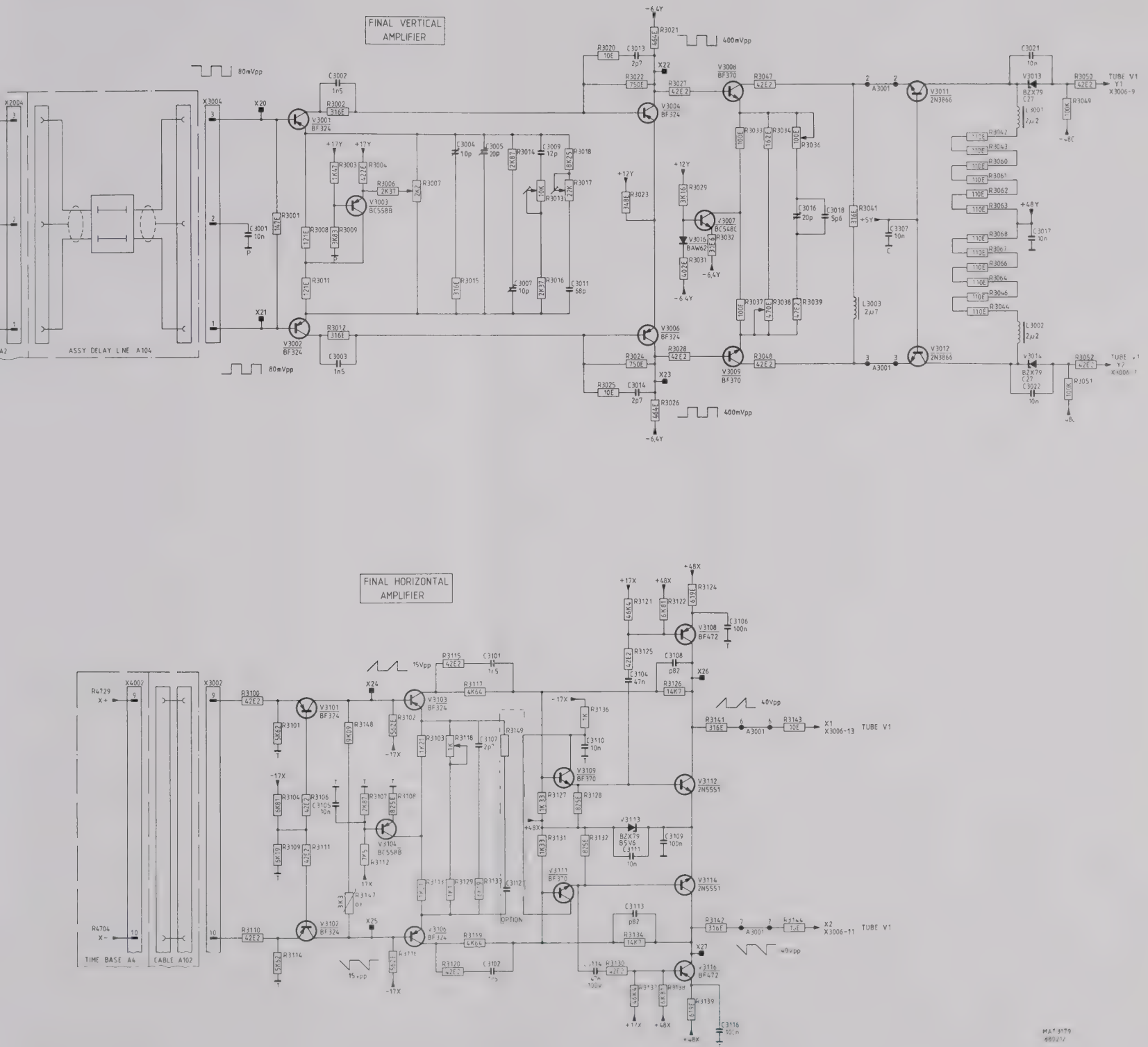
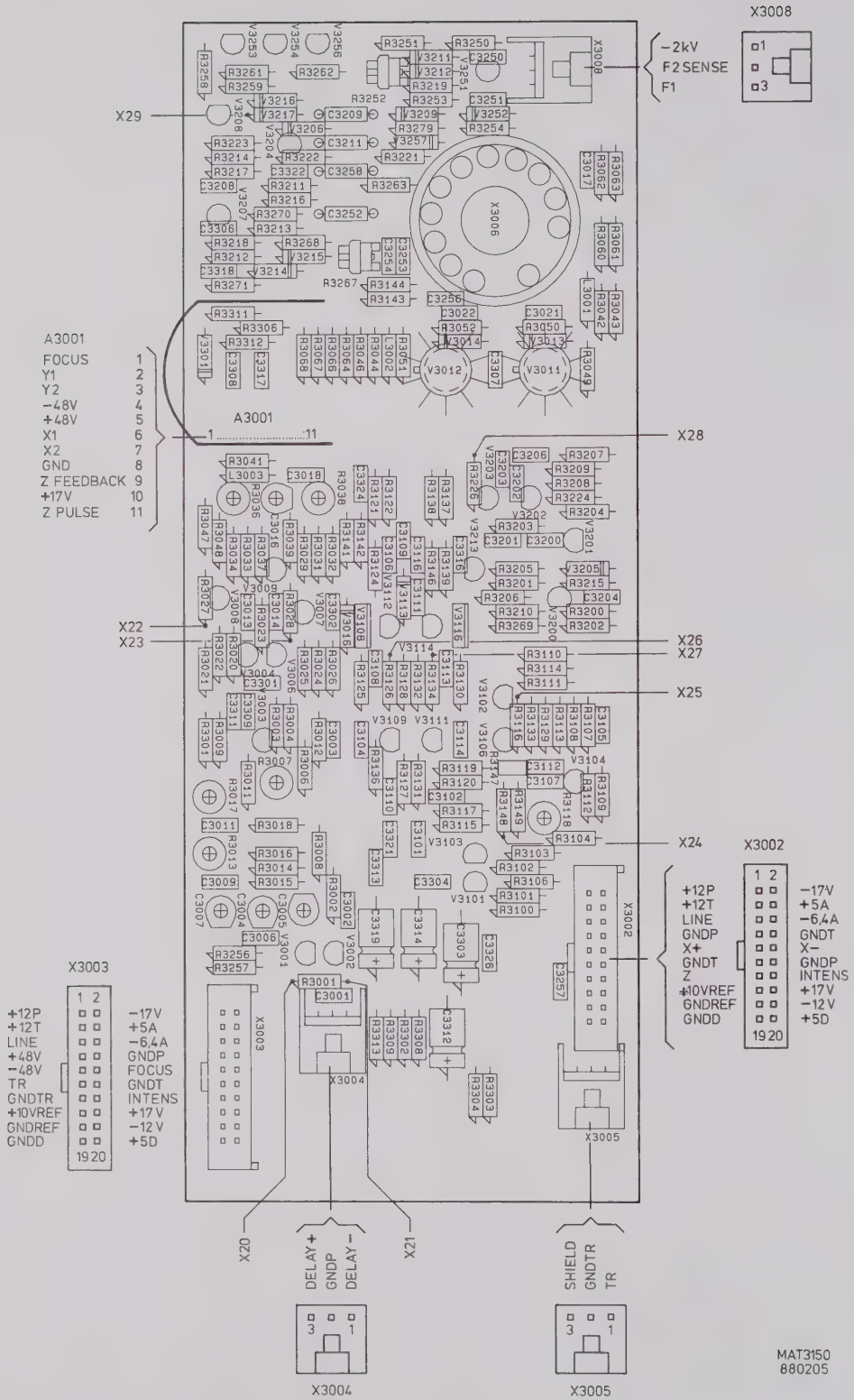


Figure 6.2 Circuit diagram of XYZ amplifier, final X and Y amplifiers



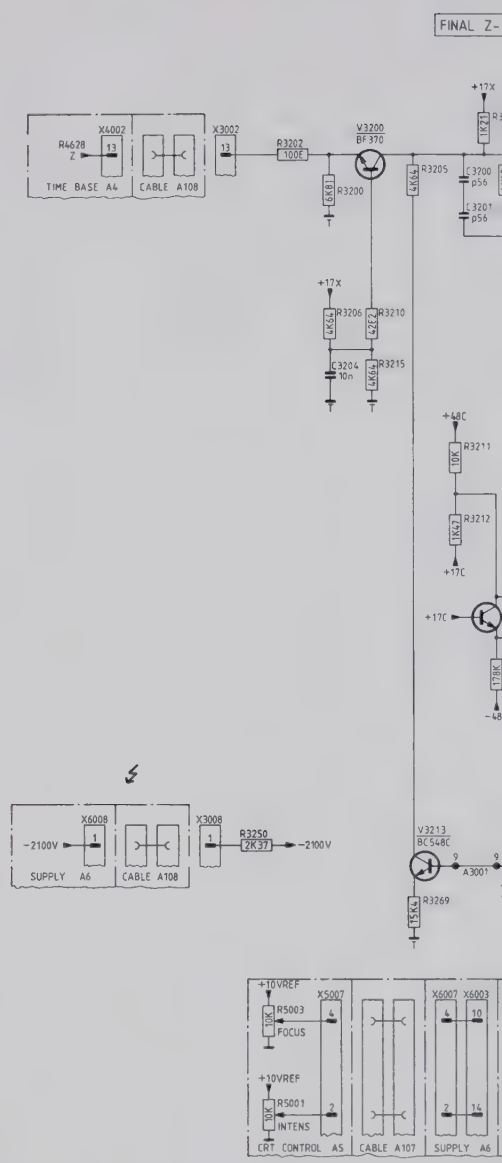


Figure 6.3 XYZ amplifier unit p.c.b.

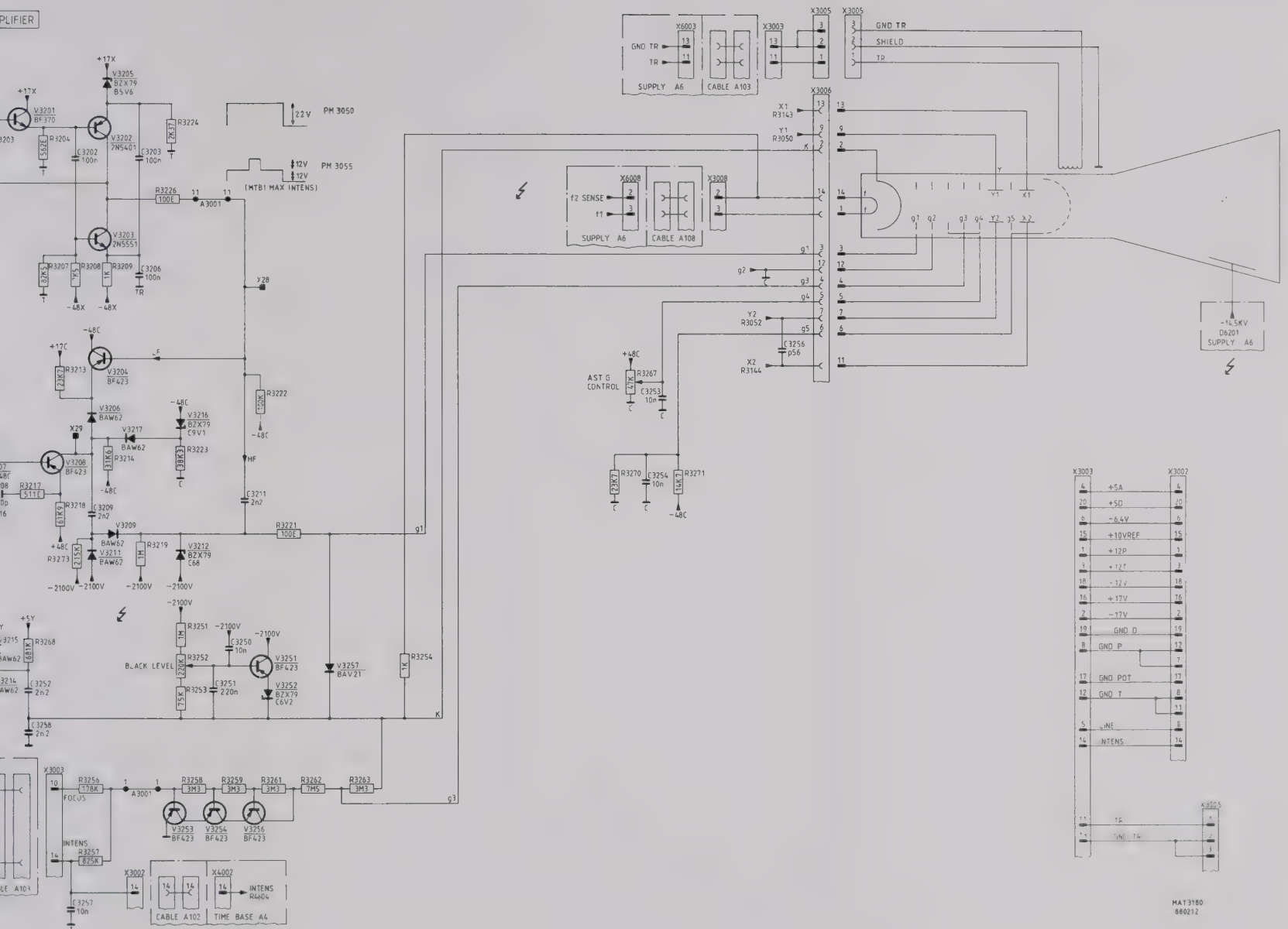


Figure 6.4 Circuit diagram of XYZ amplifier, Z amplifier and CRT circuit

7. TIME-BASE UNIT (A4)

The time-base unit consists of:

- Trigger amplifier
- Timing circuit
- Sweep generator
- X DEFL amplifier, incl. display mode switch
- Horizontal pre-amplifier
- Z amplifier

As a supplement, the timing diagram for several conditions of the time base is given in section 7.6.

All control pulses for this unit are generated by the time-base control circuit, via the I^2C bus. Integrated circuits D4001 and D4002 convert this series DATA into the parallel control pulses, provided that DLEN TB1, and DLEN TB2 are HIGH.

7.1 TRIGGER AMPLIFIER

* TB triggering:

The symmetrical trigger current signals TRIGM+ and TRIGM- are derived from the pre-amplifier unit and converted into the asymmetrical trigger voltage via the shunt feedback amplifier V4003 and V4006. The amplifier of this trigger signal is the summation of the voltage swings across R4002 and R4003, which are proportional to the current swing of TRIGM+ and TRIGM-.

* TV triggering:

When the signal TVMTB goes LOW, the normal trigger path is blocked via V4005 and V4007 and the trigger signal is routed via the TV trigger stage V4009...V4018. Transistor V4009 serves to clip the synchronisation pulse and LINE/FRAME selection is obtained by 4016.

7.2 TIMING CIRCUIT (see figure 7.1)

The timing for the entire time-base circuit is obtained by D4103 together with its associated components.

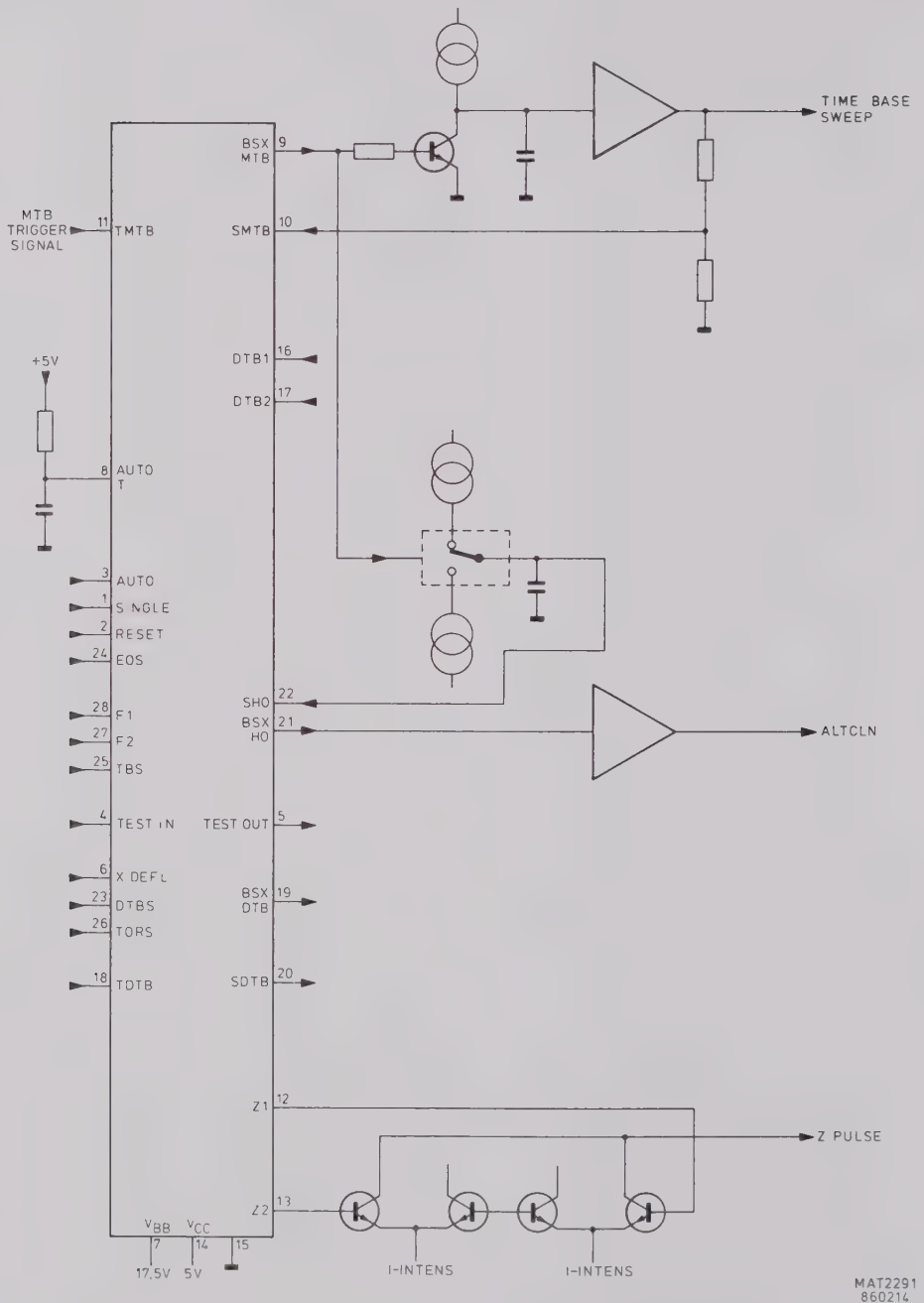


Figure 7.1 D4103 configuration

D4103 has the following relevant pin connections:

Pin	Name	INPUT-OUTPUT	Description
1	SINGLE	TTL-input	Selects the single time-base mode.
2	RESET	TTL-input	Stops the sweep and starts the hold off sweep.
3	AUTO	TTL-input	Selects the AUTO trigger mode, the time base is free-running after the last trigger pulse.
4	TESTIN	TTL-input	Selects the possibility to drive several functions (TESTOUT) in combination with SINGLE and RESET.
5	TESTOUT	TTL-output	--
6	X DEFL	TTL-input	Activates the Z1 and Z2 outputs.
7	Vbb	-	+1,5 V supply input.
8	AUTOTIME	input	RC-time determination (100 ms) for the AUTO trigger mode.
9	BSXMTB	TTL-output	Discharges the TB-sweep capacitor(s).
10	SMTB	SCHMITT-input	Determines the end of the TB-sweep.
11	TMTB	SCHMITT-input	Determines the start of the TB-sweep.
12	Z2	TTL-output	Determines the blanking of the CRT.
13	Z1	TTL-output	Determines the blanking of the CRT.
14	GND	-	Ground.
15	Vcc	-	+5 V supply input.
16	DTB1	-	not used
17	DTB2	-	not used, connected to ground.
18	TDTB	-	not used
19	BSXDTB	-	not used
20	SDTB	-	not used
21	BSXHO	TTL-output	Determines the ALT clock pulse
22	SHO	SCHMITT-input	Determines the end of the Hold-off sweep.
23	DTBS	-	not used; connected to +5 A.
24	EOS	-	Not used; connected to +5 A.
25	TBS	TTL-input	Determines the TB-unblanking (HIGH)
26	TORS	TTL-input	Determines the STARTS condition (LOW) or TRIG'D condition (HIGH) of the DTB.
27	F1	TTL-input }	Determines the time base display mode (both LOW).
28	F2	TTL-input }	

NOTE: All SCHMITT-inputs are at +2,5 V level.

7.3 SWEEP GENERATORS

* TB sweep generator (see figure 7.2):

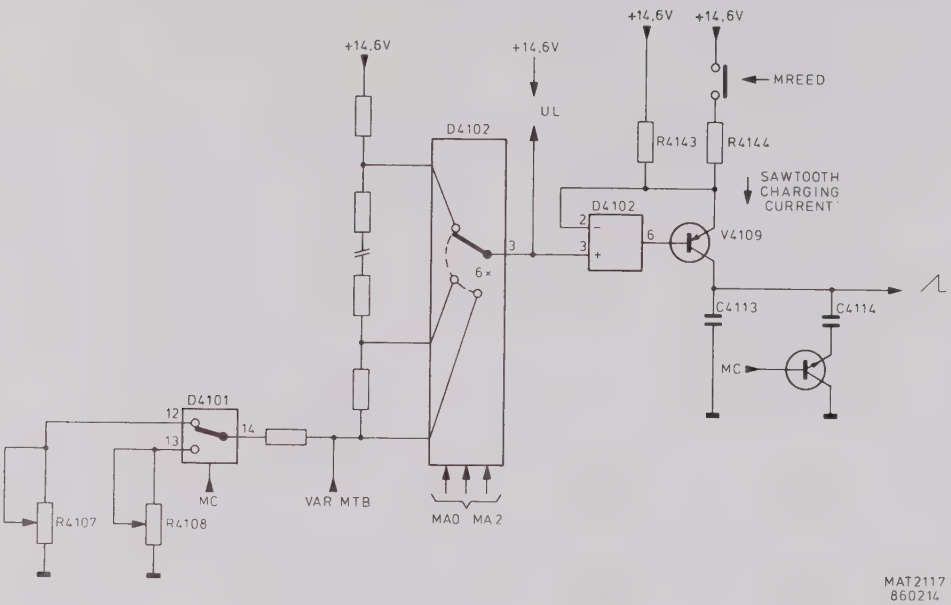


Figure 7.2 Simplified diagram of the time-base sweep generator

The sawtooth charging current $\frac{U1}{R4143 \text{ (and } R4144)}$ determines the sweep speed via C4113 (+C4114).
The circuit is controlled by the following address lines:

- MA0...MA2, for interconnection of D4102-3 to an input pin, thus giving six different voltage levels U1 with respect to +14,6 V.
- MREED, for addition of R4144 to the sawtooth charging circuit.
- MC, for addition of C4114 to the sawtooth charging circuit and for switching over between calibration pot.meters R4107 (50ns...100us) and R4108 (200 us...0,5 s).

The voltage U1 can be continuously varied by moving the VAR TB control R7009 from the CAL position. Thus a sweep variation of 1:2,5 can be obtained.

The function table for the sweep generator is given below:

sweep speed	MA2	MA1	MA0	MREED	MC
50 ns	1	1	1	0	0
.1 us	0	1	0	0	0
.2	0	0	1	0	0
.5	0	0	0	0	0
1	0	1	1	0	0
2	1	0	0	1	0
5	1	1	1	1	0
10	0	1	0	1	0
20	0	0	1	1	0
50	0	0	0	1	0
.1 ms	0	1	1	1	0
.2	1	0	0	0	1
.5	1	1	1	0	1
1	0	1	0	0	1
2	0	0	1	0	1
5	0	0	0	0	1
10	0	1	1	0	1
20	1	0	0	1	1
50	1	1	1	1	1
.1 s	0	1	0	1	1
.2	0	0	1	1	1
.5	0	0	0	1	1

NOTE: when MREED is low, then RELAY is switched on.

The sawtooth current is fed to the buffer circuit, where the h.f. sweep components (to 2 usec) are routed via C4116 and V4118, V4119.
The 1.f. sweep components (0,5 sec...2usec) is routed via N4103.

Finally the time-base sweep voltage is applied to the horizontal display mode switch.

*Hold-off circuit

During the time base sweep, capacitor C4304 is discharged. In the lower sweep speeds (lower then 10us) capacitor C4302 is also discharged via V4306. After the sweep, the capacitor(s) are charged via current source V4304 until the voltage across C4304 reaches the +2,5 V level.
This voltage is applied to D4103 as the SHO signal and determines if the time base can generate a new sweep.

Depending on the HOLD OFF control potentiometer R7011 adjustment, a part of the charging current leaks away via V4301 and thus continuously variation of the charging time (i.e. hold-off time) is obtained. When BSXMTB goes LOW, the time base starts to run again and at the same time C4304 (and C4302) are discharged again via V4309.

7.4 X DEFL AMPLIFIER, AND DISPLAY MODE SWITCH

* X DEFL amplifier

The circuit for converting the symmetrical X DEFL+ and X DEFL- signals into the asymmetrical voltage, applied to the display mode switch is identical to the trigger input. However, this circuit can be switched-off by diodes V4500 and V4505, provided that the X DEFL signal is HIGH.

* Horizontal display mode switch:

The two deflection signals TB or X DEFL are switched to the horizontal pre-amplifier via a diode switch. This switch is under control of the signal X DEFL, when X DEFL is HIGH the X DEFL signal is applied to R4701 on the horizontal pre-amplifier stage and when X DEFL is LOW, the time base sawtooth is applied to R4701.

7.5 Z-AMPLIFIER

* Z-switch:

The Z-switch N4601 is configured as two differential amplifiers with a common current output to R4625. The stage is supplied by a constant current source via pin 1 and pin 8. The inputs Z1 and Z2 are derived from the timer stage D4103 and determine the unblanking of the CRT. For this oscilloscope Z1 and Z2 must be HIGH for normal intensity of the time base signal.
The amplitude of the Z-current can be varied by the front-panel INTENS control R5001. The slider of this control potentiometer drives the base pin 2 and pin 7 of both current sources.

To prevent burn-in of the CRT in the lower sweep speeds 0,5 sec...50 usec, signal ZB is LOW and reduces the voltage to pin 2 and pin 7.

Signal ZA is a software-controlled pulse to blank the trace when the AMPL/DIV switch is used.

* Z Pre-amplifier:

In normal condition, the fully current for CRT blanking derived from N4601 is routed via R4625, V4612 and R2628 to the XYZ Amplifier A3.

However, there are two conditions for additional blanking:

- In the chopped mode of the vertical channels the display is blanked during switching over between channels. This happens by connecting the CHOPBLN pulse to V4611. When this pulse is HIGH, transistor V4611 conducts and a part of the blanking current flows via V4611 e-c to the +5 kV rail.
- if a HIGH level is applied to the external Z MOD input on the rear panel, this signal causes conducting of V4616 so that a part of the blanking current flows via V4616 e-c to the +5 kV rail.

7.6 TIMING DIAGRAM

The following figure gives the timing diagram for D4103 for a free running time base sweep.

SINGLE	0
RESET	0
AUTO	1
TEST IN	0
X DEFL	0
TORS	0
F1	0
F2	0
DTBS	0
EOS	1
TBS	1

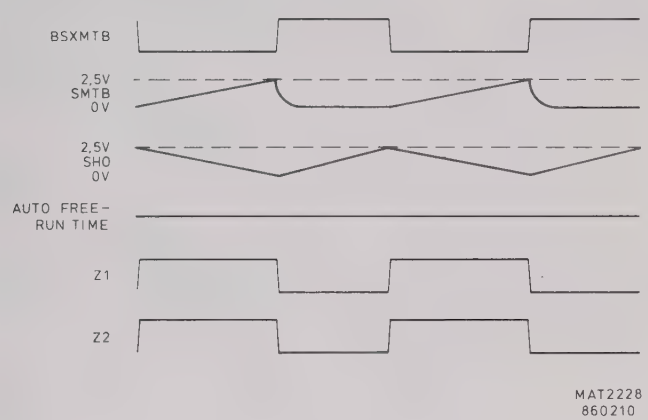


Figure 7.3 Free-running sweep-timing diagram

7.6 TIMING DIAGRAM

The following figure gives the timing diagram for D4103 for a free running time base sweep.

SINGLE	0
RESET	0
AUTO	1
TEST IN	0
X DEFL	0
TORS	0
F1	0
F2	0
DTBS	0
EOS	1
TBS	1

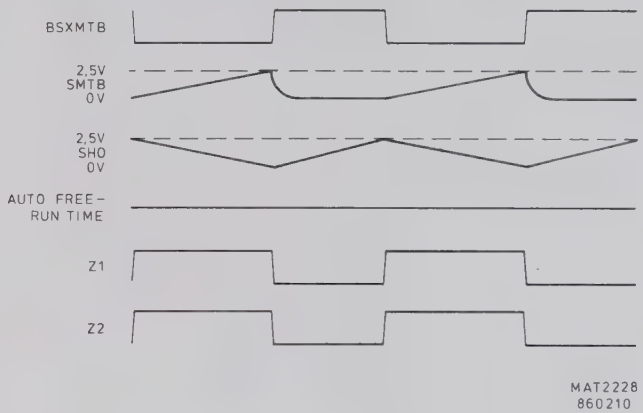


Figure 7.3 Free-running sweep-timing diagram

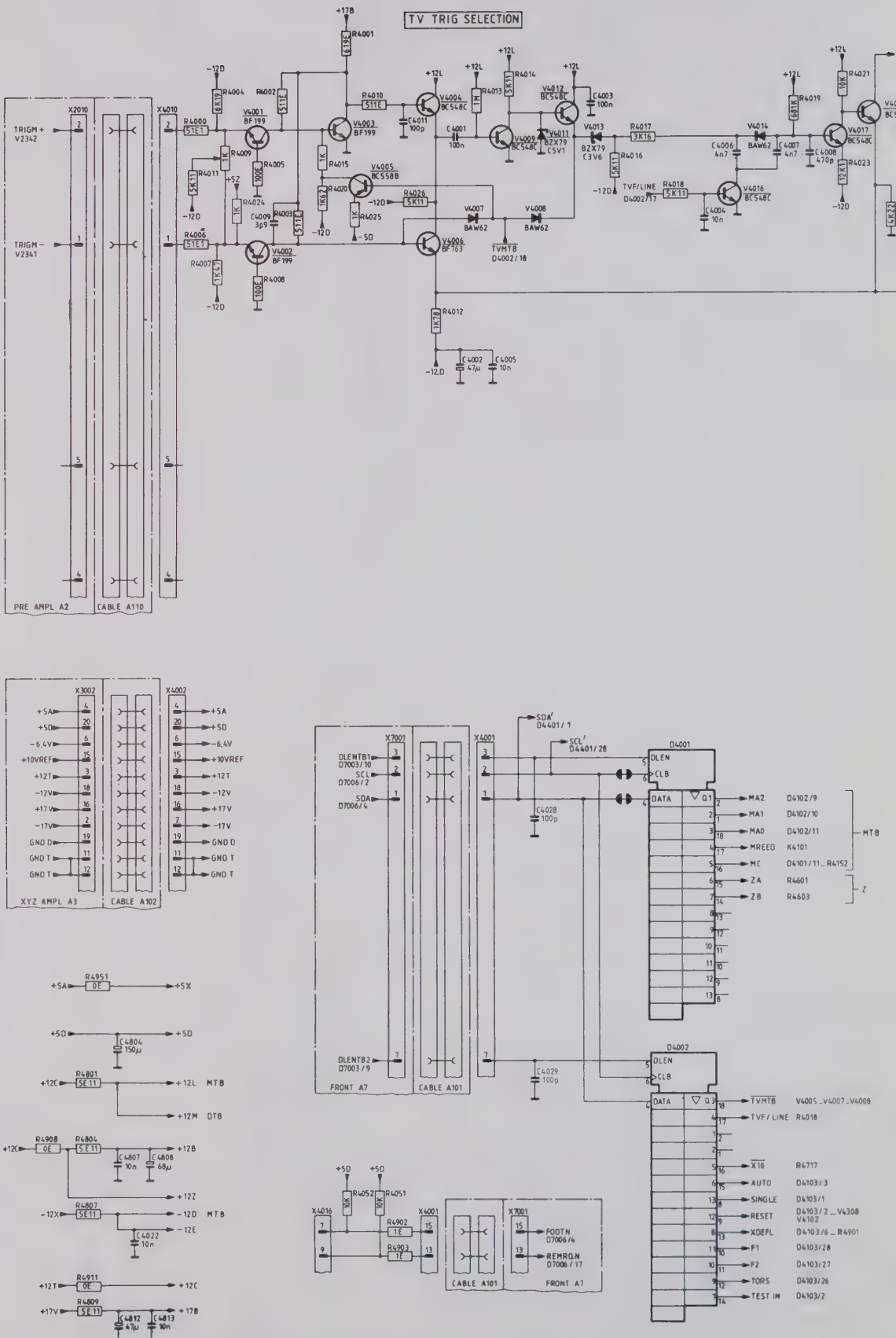
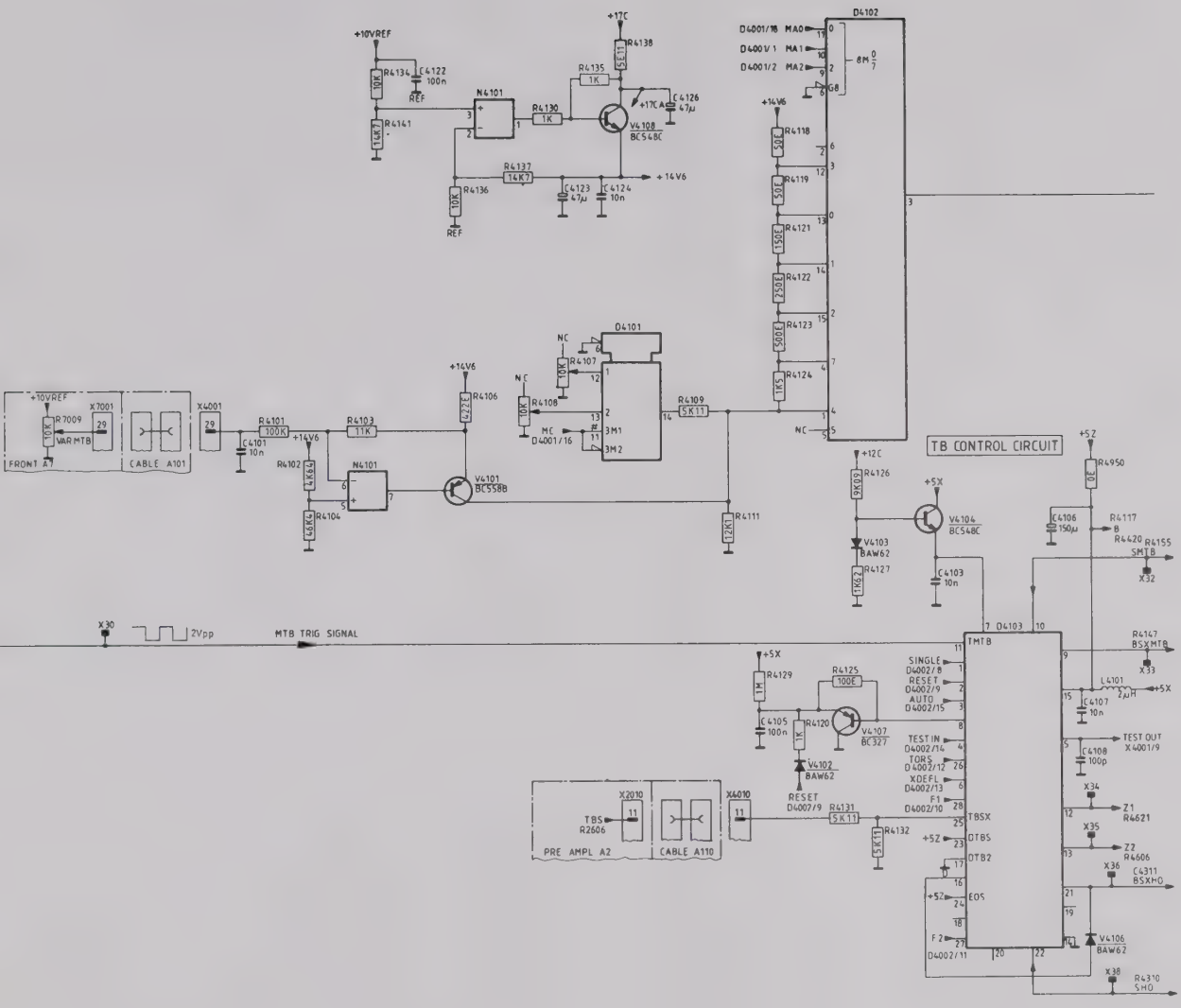
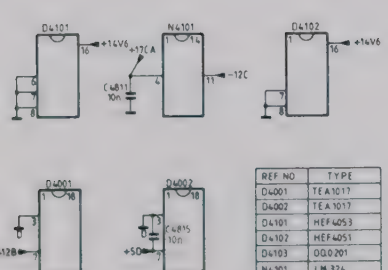
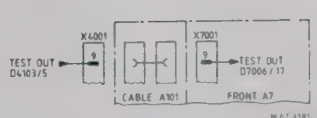


Figure 7.4 Circuit diagram of time base, trigger amplifier





REF NO	TYPE
D4001	TEA1017
D4002	TEA1017
D4101	HEF4053
D4102	HEF4051
D4103	OQ0201
N4101	LM 324



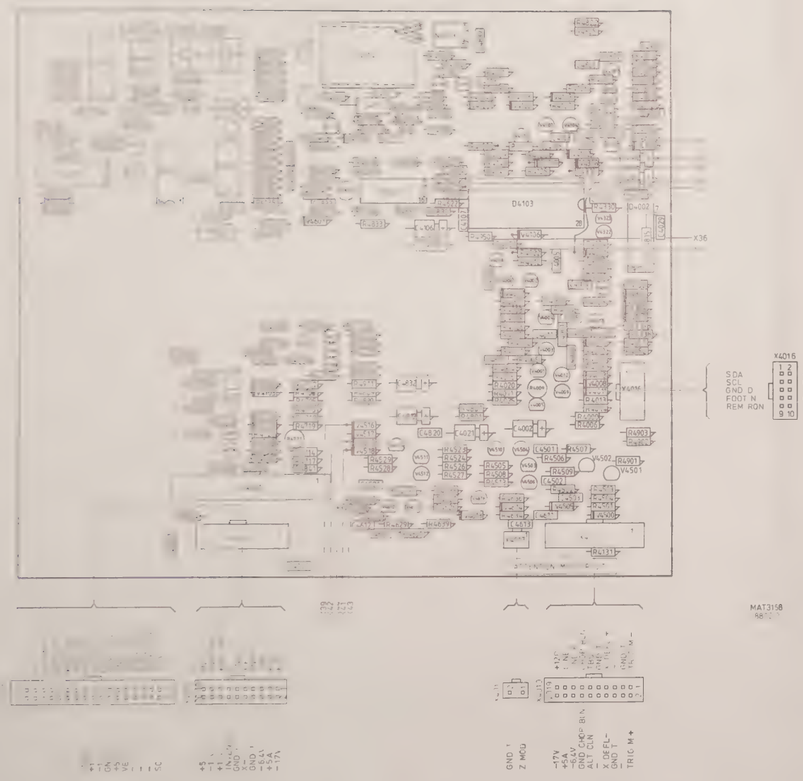


Figure 7.5 Time base unit p.c.b.

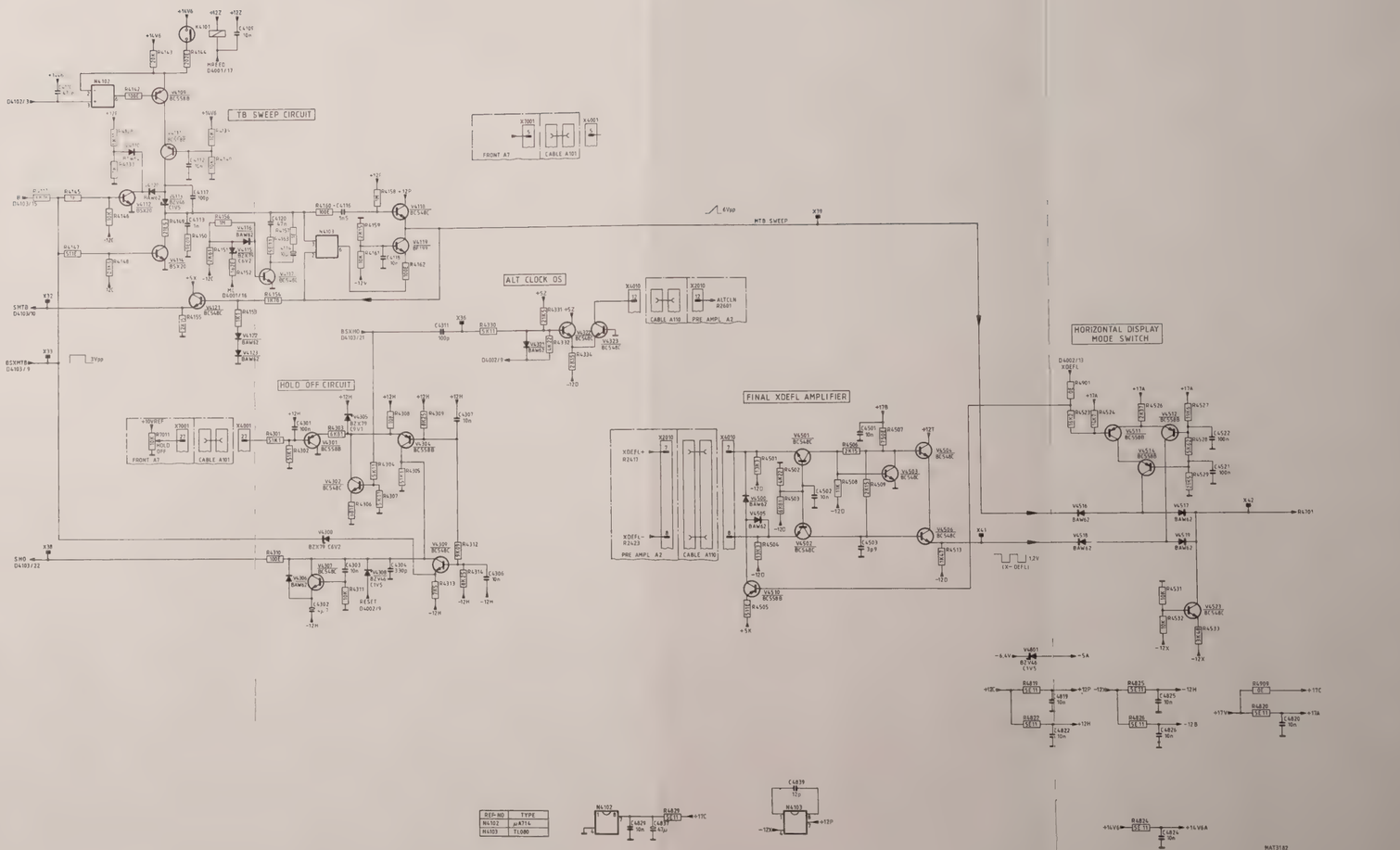


Figure 7.6 Circuit diagram of time base, sweep circuit and final X DEFL amplifier

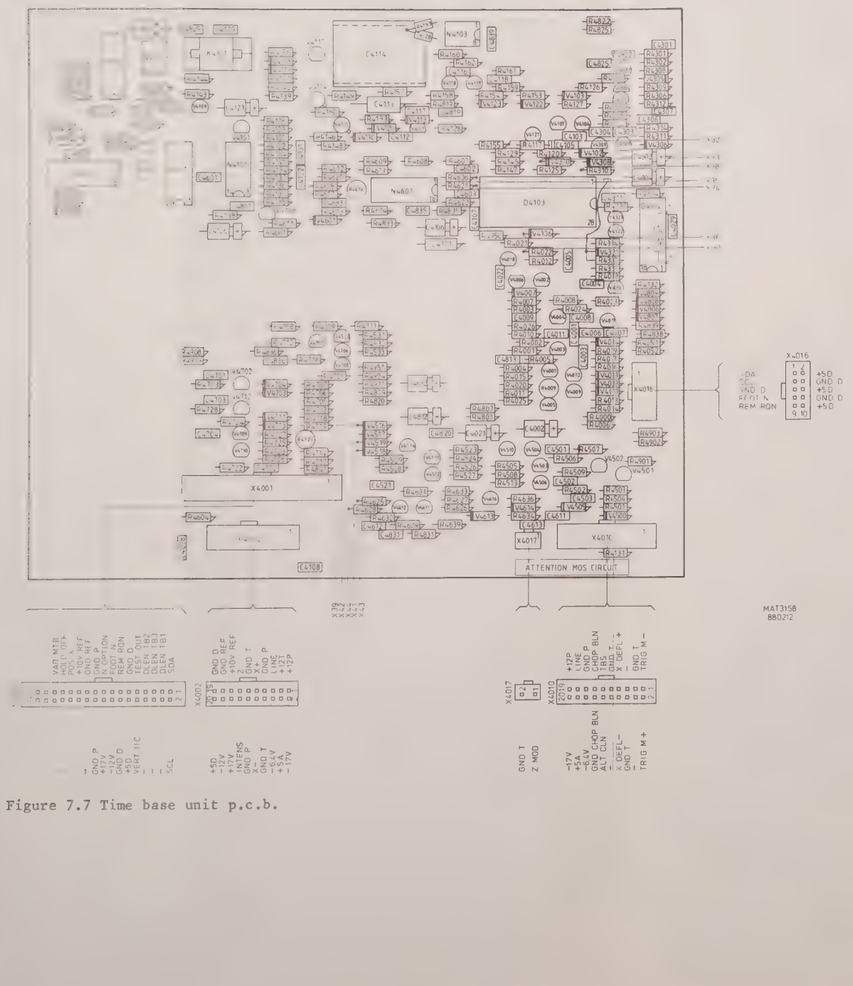


Figure 7.7 Time base unit p.c.b.

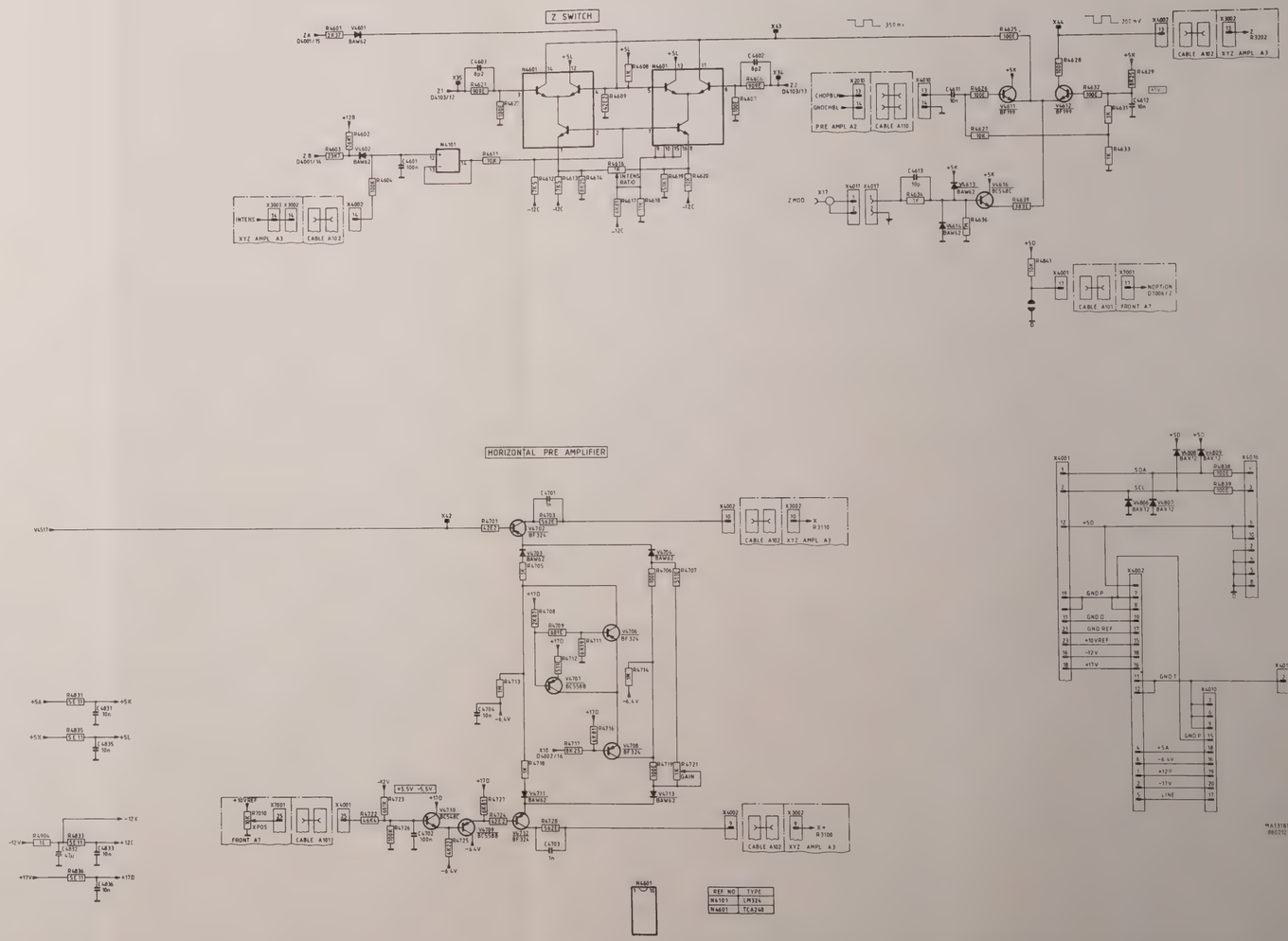


Figure 7.8 Circuit diagram of time base, X pre-amplifier and Z-switch

8. CRT CONTROL UNIT (A5)

This unit incorporates the potentiometers that control the CRT functions. These potentiometers are INTENS (R1), screwdriver operated control TRACE ROT (R2), FOCUS (R3) and ILLUM (R4).
The range of these potentiometers is between 0 V and +10 V.
The way these potentiometers influences the associated circuit is described together with the description of the relevant circuit part.

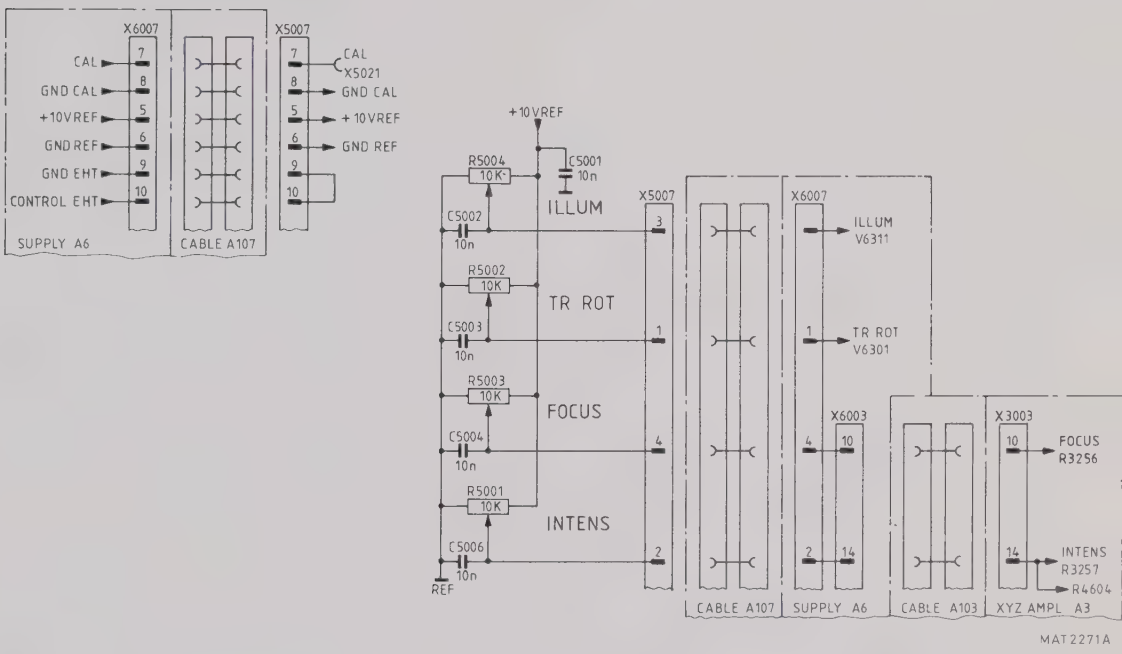


Figure 8.1 Circuit diagram of CRT control

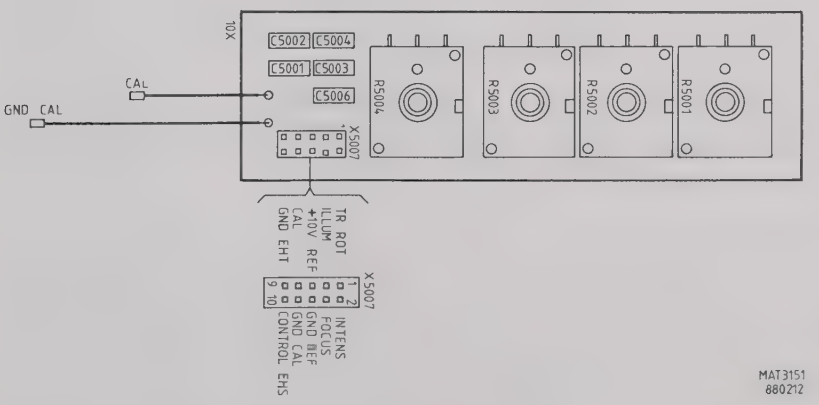


Figure 8.2 CRT control unit p.c.b.

9. POWER SUPPLY UNIT (A6)

Basically, the power supply unit consists of:

- input circuit
- converter circuit
- secondary output rectifiers
- HT supply
- CAL oscillator
- CRT control circuit

9.1 INPUT CIRCUIT

The instrument may be powered from a nominal mains voltage of 100 V...240 V a.c.
The mains voltage is primary protected by a fuse of 1,6 AT, which is located on the rear of the instrument.

After rectification by the diode bridge V6001...V6004 a d.c. voltage is applied to the converter circuit.
This voltage is smoothed by capacitors C6007, C6008 and choke L6000, L6001 and L6002.
Depending on the mains voltage, the rectified voltage is 120 V...370 V.

WARNING: All measurements on the INPUT CIRCUIT and the CONVERTER CIRCUIT should be done with a floating oscilloscope. As reference voltage can be used measure point X48.

A fixed part of the mains voltage serves as a LINE-trigger signal.
The amplitude of the LINE trigger signal is 1/22x MAINS.

NOTE: The LINE trigger signal is <u>not</u> present when a d.c. voltage serves as MAINS.

9.2 CONVERTER CIRCUIT (see figure 9.1 and figure 9.2)

The flyback converters consists of transistor V6014 and V6018 and their associated components. The converter frequency depends on the LINE IN amplitude and is for 110 Vac: 30 kHz approx and for 220 Vac: 45 kHz approx.

Transistors V6014 and T6018 conduct on the forward stroke and charge transformer T6001. The thyristor V6013 fires when the voltage on the gate reaches the firing level (0,6 V approx). Consequently, V6018 blocks - V6014 blocks, for the duration of the flyback stroke, during which the secondary windings discharge via the diode rectifiers into the smoothing capacitors. The NTC resistor R6009 provides temperature compensation for the firing point of the thyristor.

During the flyback, capacitor C6009 charges again via the path T6001-1, V6012, V6009, R6004, C6009, L6002 and T6001-2.

The voltage stabilizer with transistor V6009 gives a square-wave to the gate of transistor V6014 with a maximum amplitude of 15 V.

The dv/dt limiter with L6004, L6006, V6017 and V6019 serves to eliminate the switching spikes present on the collector of V6018 (measuring point X46).

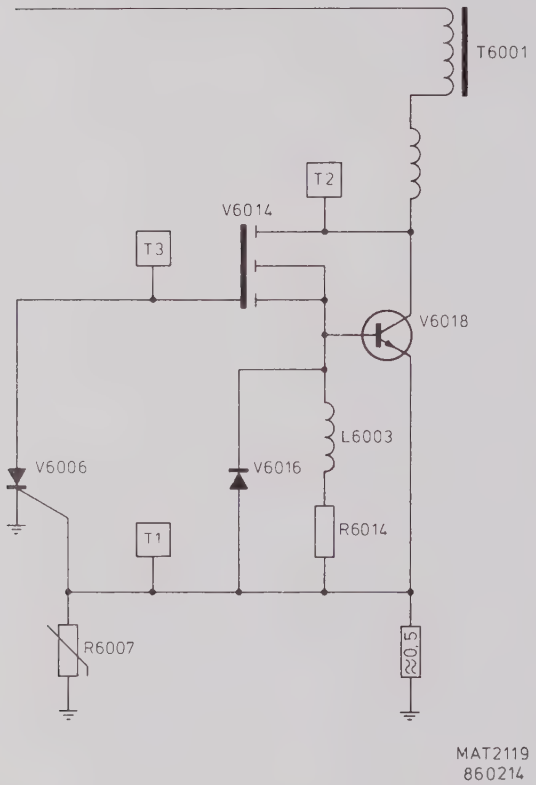


Figure 9.1 Converter circuit

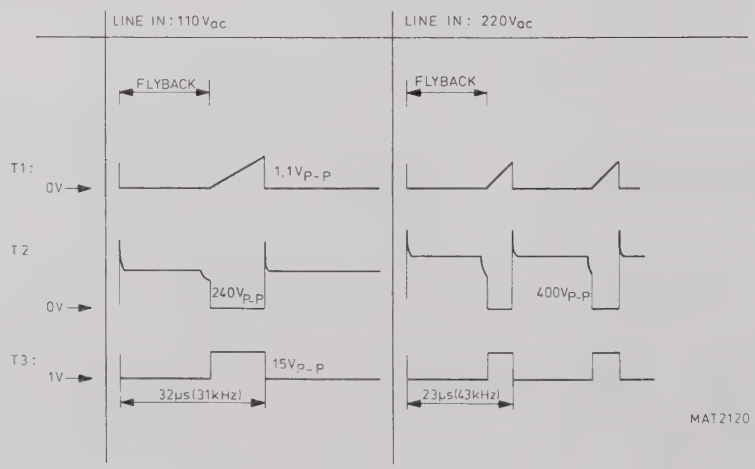


Figure 9.2 Timing diagram converter circuit

9.3 SECONDARY OUTPUT RECTIFIERS

The output voltages taken from the secondary windings of transformer T6001 are rectified by diodes and smoothed by capacitors in conventional circuits.
A "CROWBAR" circuit with transistor V6137 and V6112 protects the +5 V supply.
When the +5 V level is too high, transistor V6137 (and V6112) conduct and the power supply goes into short circuit mode.

A voltage protection circuit using V6134, V6136 and V6112 protects against overloads protection. When the power supply is overloaded, these components conduct and the power supply goes into in the short-circuit mode.

9.4 HT SUPPLY

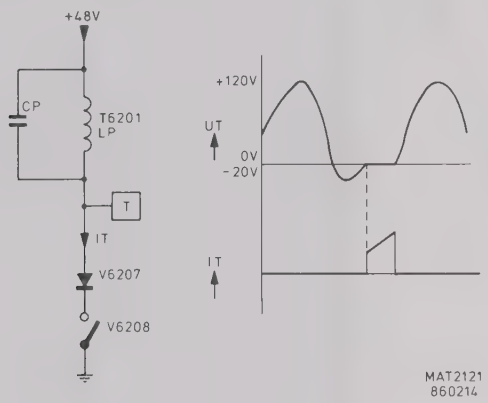


Figure 9.3 HT oscillator

The HT supply consists of an oscillator and a regulator circuit. Transformer T6201 determines the frequency (50 kHz approx.) of the oscillator. The output signal voltage on the secondary winding of T6201 is rectified by diode V6209 and smoothed by C6211. The -2,1 kV is also converted to -14,5 kV in the HT multiplier D6201 and routed via connector X6030 to the post-acceleration anode of the CRT.

To regulate this HT voltage the -2 kV is fed to the input of OP-AMP N6002.
The output level of N6002 determines the energy to T6201, and thus the amplitude of the HT-voltage.

9.5 CALIBRATOR

The calibrator circuit consists of two analogue switches D6501(8-9) and D6501(11-12) controlled by the active HIGH enable inputs 6 and 12 respectively, that are connected as an 2 kHz astable oscillator. Capacitor C6502 and resistor R6504 determine the 2 kHz frequency. The oscillator outputs, applied to enable inputs 5 and 13 of the second stage are in anti-phase with each other. Depending on the level of input 5 and 13, the CAL voltage will have a 1,2 V level or a 0 V level.

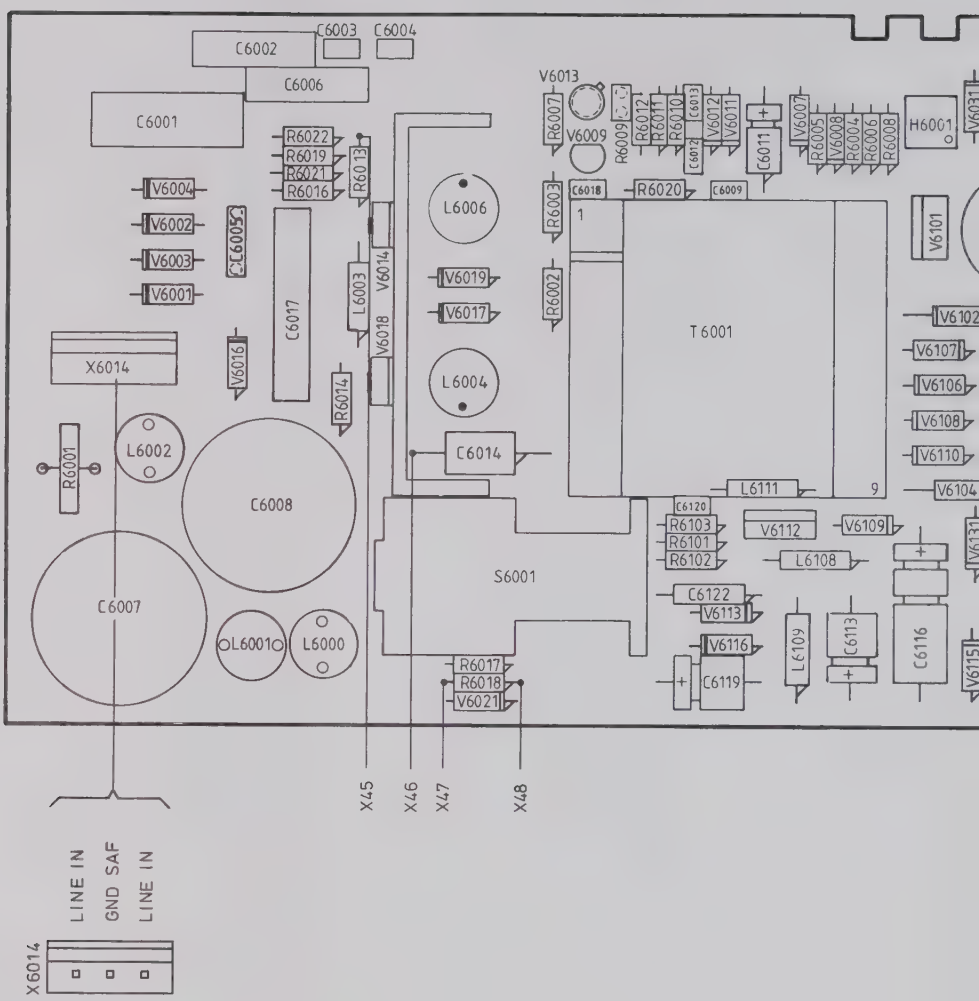


Figure 9.4 Power supply unit p.c.b.

MAT3197
880212

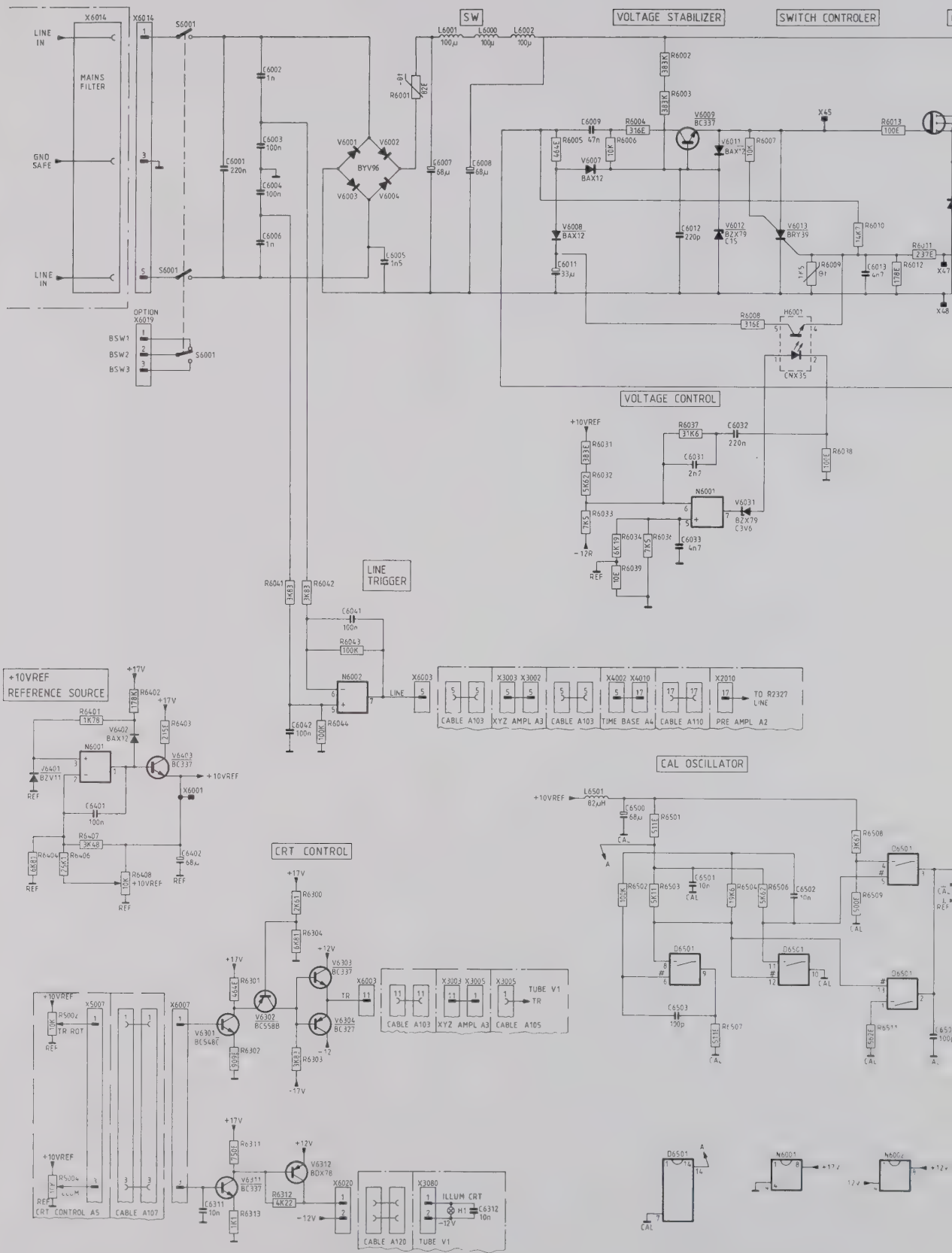
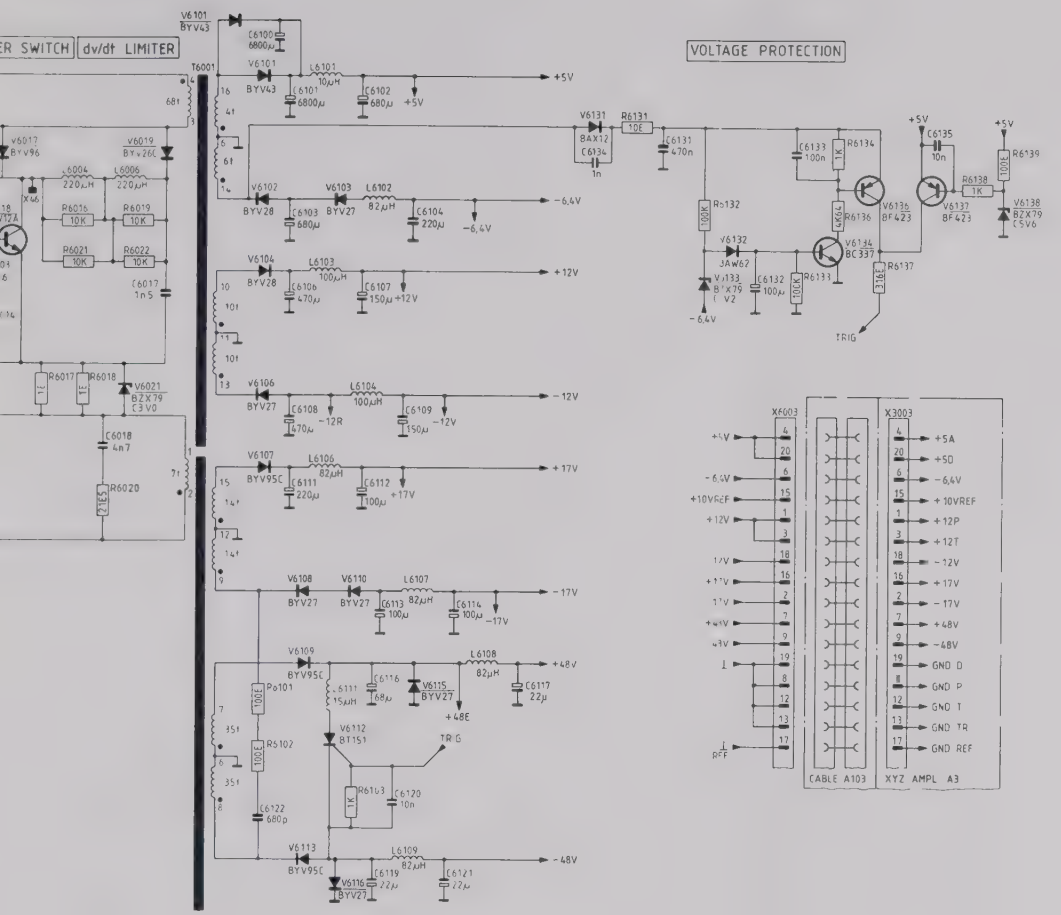
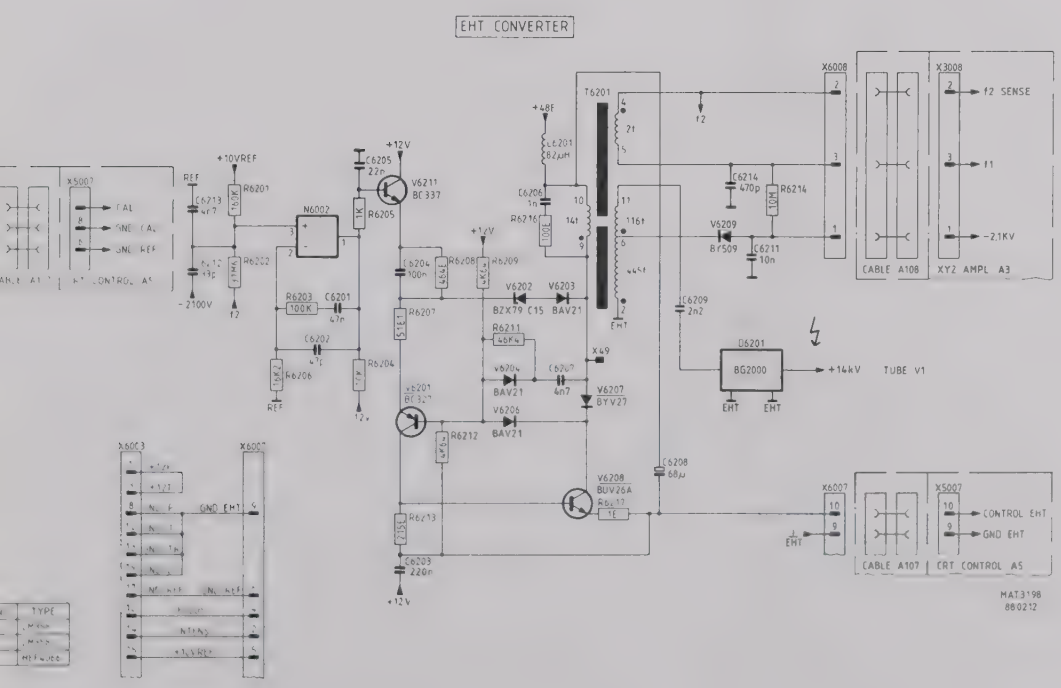


Figure 9.5 Circuit diagram of power supply


ER SWITCH
dv/dt LIMITER
VOLTAGE PROTECTION
+5V
-6,4V
+12V
-12V
+17V
-17V
+48V
-48V
TRIG
CABLE A103
XYZ AMPL A3
+5A
+5D
-6,4V
+10VREF
+12P
+12T
-12V
+17V
-17V
+48V
-48V
GND D
GND P
GND T
GND TR
GND REF


EHT CONVERTER
+10VREF
+12V
+48V
+1kV
-2100V
BG2000
+14kV
TUBE V1
f2 SENSE
f1
-2,1KV
CABLE A108
XYZ AMPL A3
CONTROL EHT
GND EHT
CABLE A107
CRT CONTROL A5
MAT.3198
860212

10. FRONT UNIT (A7-A8)

The front unit consists of:

- the microcomputer control circuit
- the LCD display circuit
- the front panel controls

10.1 MICROCOMPUTER CONTROL CIRCUIT

10.1.1 Introduction to MAB8052 microcomputer

The integrated circuit MAB8052, one of the MSC-51 family of single chip microcomputers, forms the basis of the microcomputer system of the oscilloscope. The MAB8052 has an internal 8 k ROM and 256 bytes RAM with address/data decoding facilities. In addition to this, the 8052 has 32 I/O lines. Data written to these lines remains unchanged until rewritten. Each line is able to serve as input or output, or both, even though outputs are statically latched. To provide specific serial data transfer possibilities, the microcomputer system contains an I^2C bus interface.

10.1.2 Characteristics of the I^2C bus

The I^2C bus is for 2-way, 3-line communication between different ICs or modules. The three lines are a serial data line (SDA), a serial clock line (SCL) and ground. Both lines must be connected to a positive supply via a pull-up resistor when connected to the output stages of a device. Data transfer may be initiated only when the bus is not busy.

Bit transfer:

One data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the HIGH period of the clock pulse as changes in the data line at this time will be interpreted as control signals.

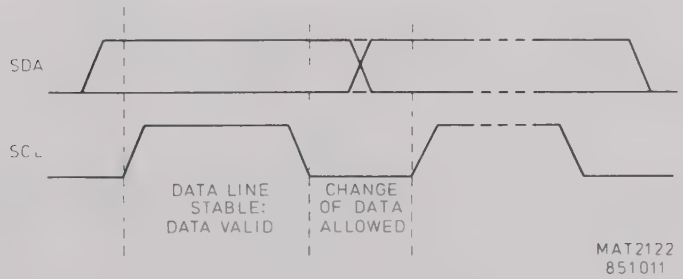


Figure 10.1 Bit transfer

Start and stop conditions:

Both data and clock lines remain HIGH when the bus is not busy. A HIGH-to-LOW transition of the data line, while the clock is HIGH is defined as the start condition (S). A LOW-to-HIGH transition of the data line while the clock is HIGH is defined as the stop condition (P).

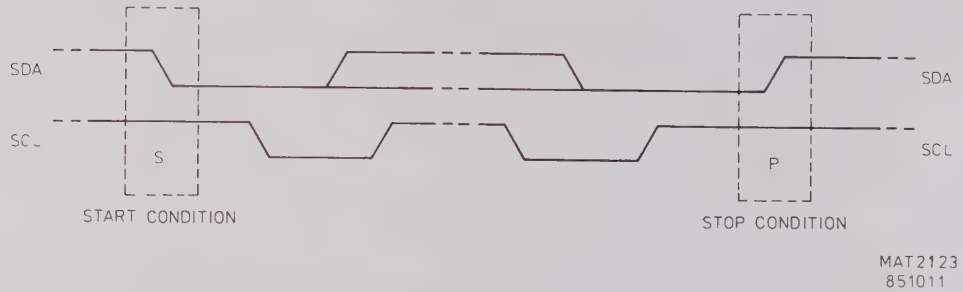


Figure 10.2 Definition of start and stop conditions

10.1.3 I^2C structure

The two lines SDA and SCL are fed to the various circuits, where, depending on the addressing, this serial information is converted into the different control signals (see figure 10.3).

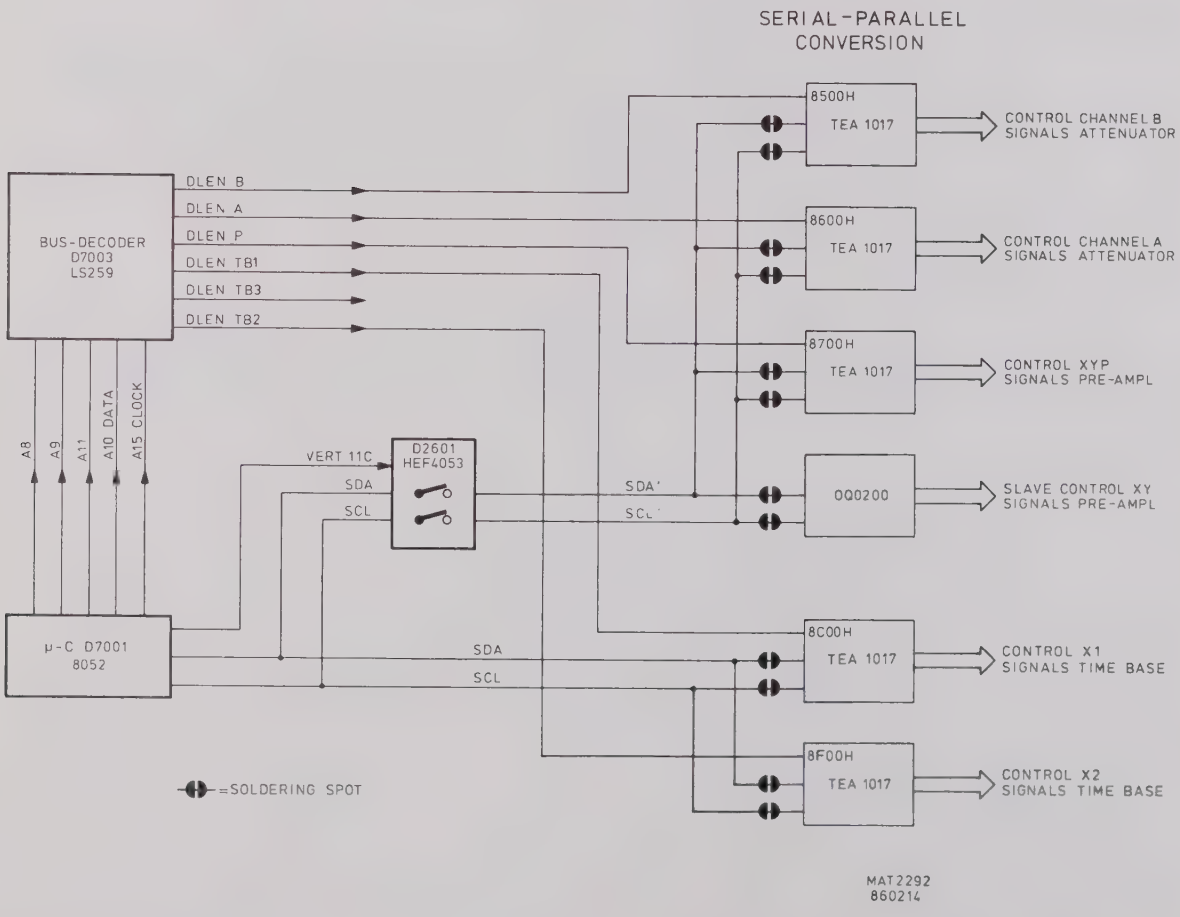


Figure 10.3 I^2C structure

To select the serial-parallel conversion circuits, the bus decoder D7003 decodes the address lines A8, A9 and A11 into the DLEN (Data latch enable) signals according to the next table

ADDRESS LINES A11	A9	A8	DATA A10		
0	0	0	1/0	8400H	SEL IIC
0	0	1	1/0	8500H	DLEN B
0	1	0	1/0	8600H	DLEN A
0	1	1	1/0	8700H	DLEN P
1	0	0	1/0	8C00H	DLEN TB1
1	0	1	1/0	8D00H	N.C
1	1	0	1/0	8E00H	DLEN TB2
1	1	1	1/0	8F00H	N.C.

To eliminate interference in the vertical circuits, the I^2C bus can be switched off for this circuit by switch D2601. The timing is obtained by the VERT IIC line.
Note that for servicing, solder joints are added in the pcb tracks connecting the circuits. These can be used to localize a fault in the I^2C-bus by means of interrupting the bus connection.

10.1.4 Microcomputer MAB8052

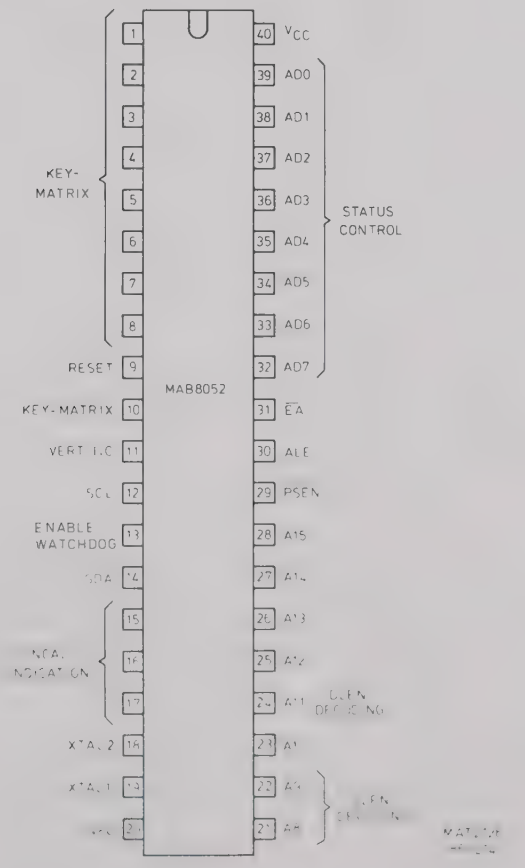


Figure 10.4 Pinning of microcomputer MAB8052

The microprocessor has the following connections:

* Crystal connections (pin 18 and 19)
  A 12 MHz crystal is connected to the inputs XTAL1 and XTAL2 to provide an accurate timing reference source.

* RESET input (pin 9)
  After switching on a reset level HIGH is applied to this input. This reset signal forces the microcomputer to initiate the main program, beginning at the address 00000H. After the +5 V supply is within its specification, the RESET is released and the microcomputer is ready for use.

* 8-bit quasi bidirectional I/O port (pin 1...pin 8) and quasi-bidirectional I/O port (pin 10), used to read the settings of the KEY-MATRIX switches S2...S32 (excl. S12-AUTOSET)

* 3-bit quasi-bidirectional I/O port (pin 15...pin 17), used to read the UNCAL position of S5, S7 and S9 (UNCAL when logic HIGH).

* WATCHDOG input (pin 13)
  The WATCHDOG is a facility to control the correct function of the software. When HIGH the internal counter will run. The software gives a pulse every 64 ms max. to reset this counter, so that the 64 ms max. cycle starts again. If the software does not function correctly, the internal counter receives no reset pulse and the counter will overflow initiating the main program (start address 0000H).

* 8-bit open drain bidirectional I/O port (pin 21...pin 28) used for addressing the serial-parallel conversion circuits (see I^2C structure).

* 8-bit quasi-bidirectional I/O port (pin 32...pin 39) used to read the status input via D7006.

* SDA (pin 14); SCL (pin 12)
  Bidirectional I^2C lines.

* VERT IIC (pin 11)
  Signal used as a digital switch control to switch-off the I^2C bus of the pre-amplifier control.

10.1.5 I^2C decoding

Integrated circuit D7002 serves as a multiplexer to make a separation between the I^2C lines for the LCD drives and the I^2C lines for the other circuits, controlled by the SEL IIC line. Only when SEL IIC is HIGH (address 8400H), are the SDA and SCL lines from the microcomputer connected to unit A8.

10.1.6 Status input

Integrated circuit D7006 serves as an input port to read the following status info:

- TEST OUT, indication for triggered mode, HIGH when triggered.
- FOOTN, remote control for AUTO SET, LOW when active.
- NOPTION, adapts software for optional trigger coupling, LOW when optional triggering.
- REMRQN, remote request line, LOW when active.
- probe indication status, adapts V/DIV reading for probe attenuation.

When the enable inputs (pin 1 and pin 19) become LOW, the status input is read and copied in the accumulator of the microcomputer via the data lines AD0...AD7.

Note that enabling is only possible when D7002-2 is switched-on to D7002-15, i.e. when A15 is HIGH (address 8000H ... FFFFH).

10.1.7 Probe indicator

Integrated circuit D7004 (OQ0044) detects the kind of probe which is connected to the oscilloscope. Depending on the resistance between the probe indication input (pin 3 for channel A and pin 16 for channel B) and ground, the V/DIV reading of the LCD automatically increases according to the next table.

Pin 3 (16)	Pin 6 (17)	Pin 7 (12)	V/DIV attenuation
2k32	0	0	x10
6k98	1	0	x100
7k68	0	1	x1
10k	1	1	x1

10.1.8 C-Bus decoder

This integrated circuit decodes the address lines A8, A9 and A11 into the DLEN signals.
During the power-up all the lines are reset to LOW.

10.2 LCD DISPLAY CIRCUIT

The LCD is driven by two drivers D8001 and D8002 (PCF8577).
The temperature dependent supply voltage VCPCF is 4 V approx. at 25°C. When the temperature increases, this voltage decreases.
The single-pin built-in oscillator on pin 37 of D8001 provides the modulation frequency for the LCD segment driver outputs. Capacitor C7008 and resistor R7038 are connected to this pin to form the oscillator, with a frequency of 150 Hz approx.
Pin 36 and pin 37 are used to determine the LCD drivers address in the I^2C bus.

The outputs pin 1...pin 32 directly drive the LCD.

10.3 FRONT-PANEL CONTROLS

The front-panel controls give a voltage between 0 V...10 V to the various circuits.
To determine the UNCAL condition of VAR A, VAR B or VAR TB, the d.c. voltages of the slider of the potentiometers are applied to comparator N7001. When the voltage level of the control is lower than 0,7 V, the microcomputer reads a logic LOW on its input and adapts the LCD display to indicate the CAL status (e.g. no flashing ">" sign visible).

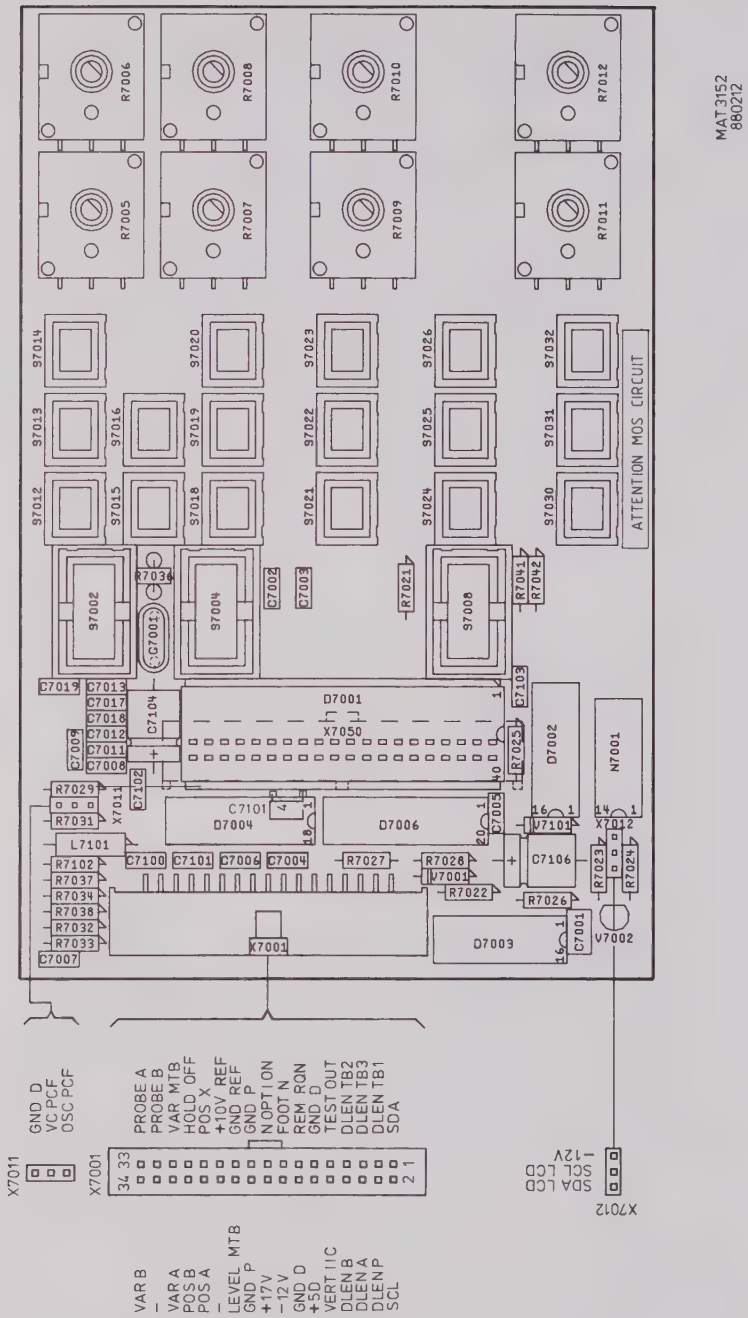
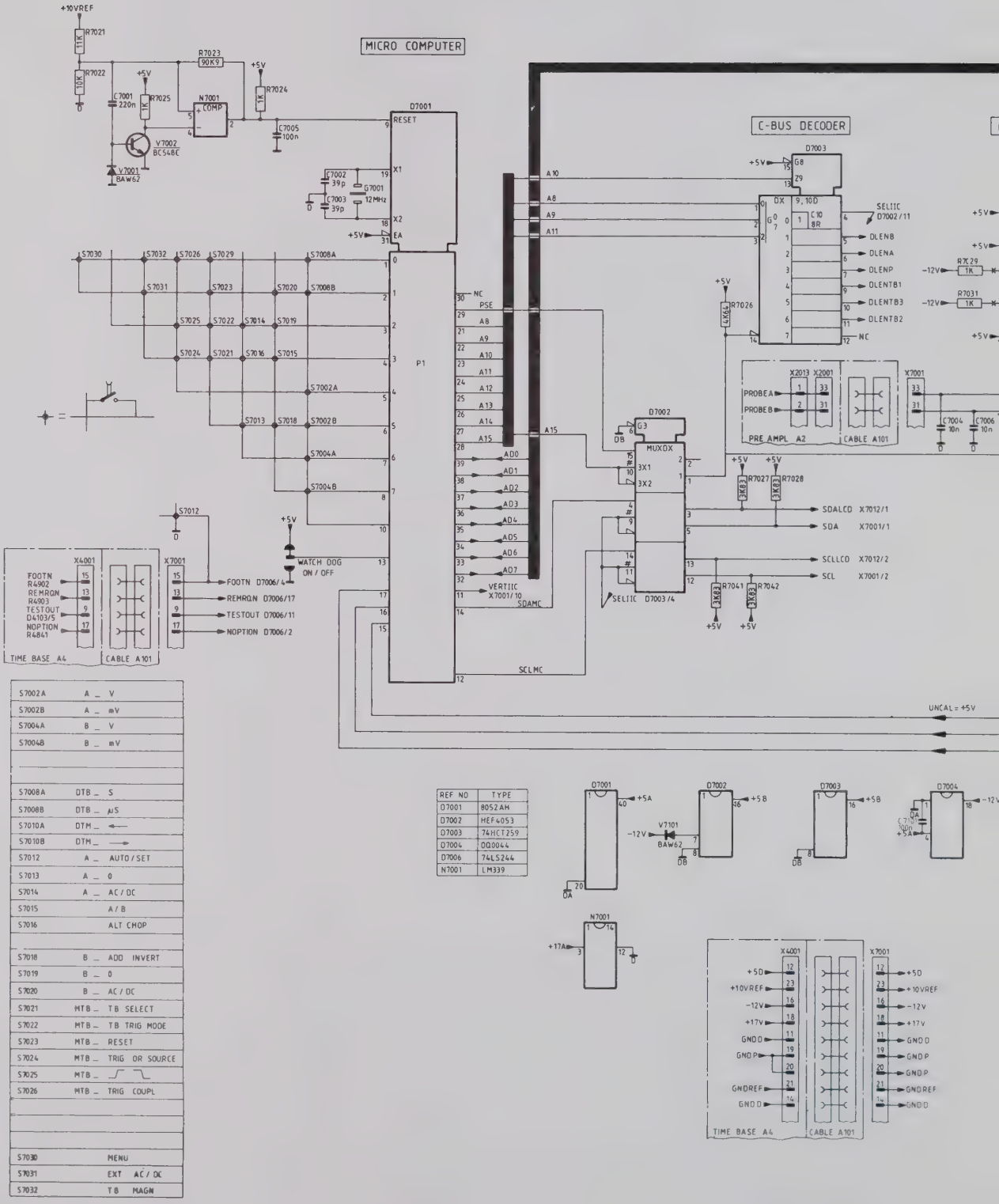


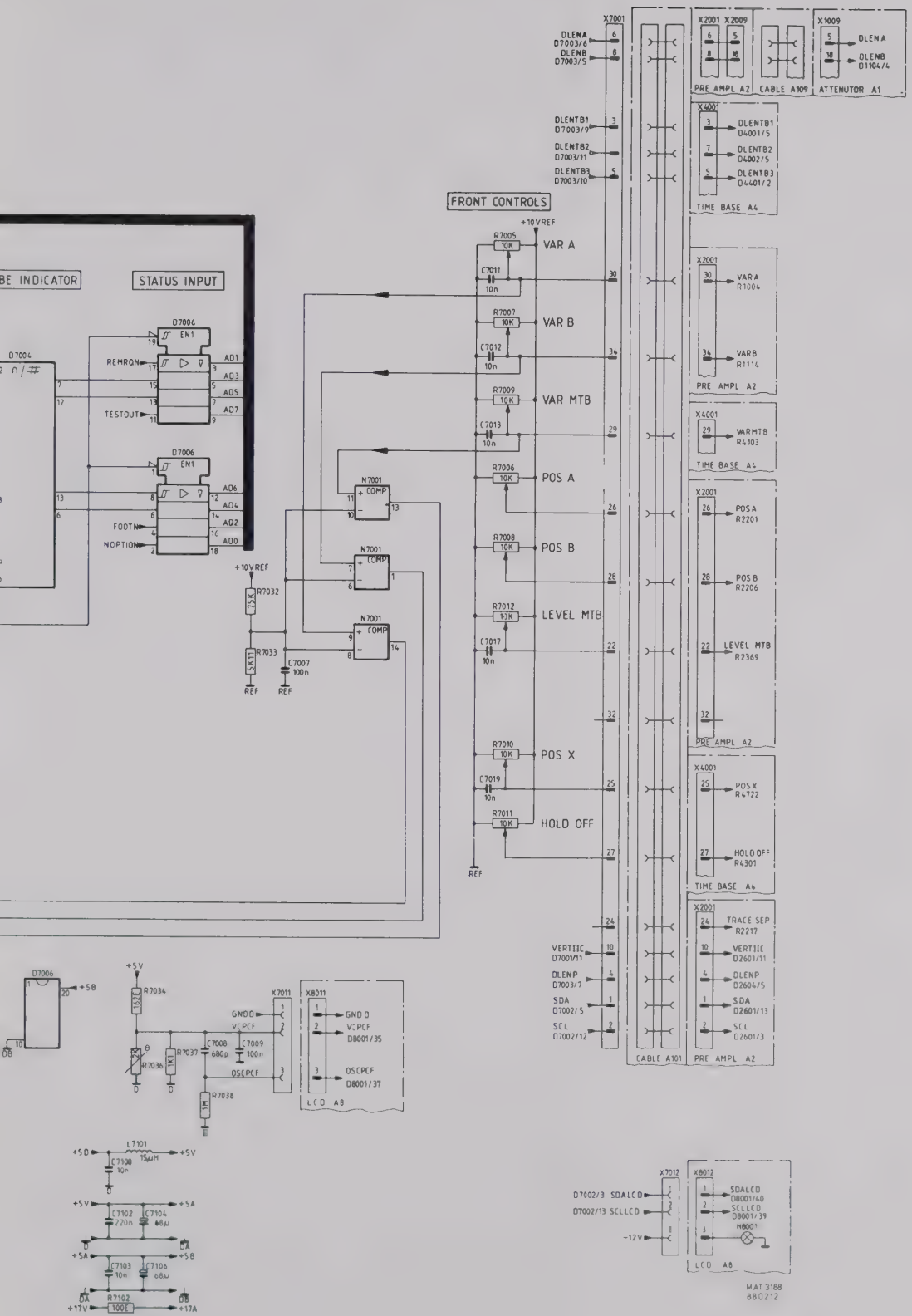
Figure 10.5 Front unit p.c.b.



S7002A	A _ V
S7002B	A _ mV
S7004A	B _ V
S7004B	B _ mV
S7008A	DTB _ S
S7008B	DTB _ µS
S7010A	DTM _ ←
S7010B	DTM _ →
S7012	A _ AUTO / SET
S7013	A _ 0
S7014	A _ AC / DC
S7015	A / B
S7016	ALT CHOP
S7018	B _ ADD INVERT
S7019	B _ 0
S7020	B _ AC / DC
S7021	MTB _ TB SELECT
S7022	MTB _ TB TRIG MODE
S7023	MTB _ RESET
S7024	MTB _ TRIG OR SOURCE
S7025	MTB _ ⎍ ⎎
S7026	MTB _ TRIG COUPL
S7030	MENU
S7031	EXT AC / DC
S7032	TB MAGN

REF NO	TYPE
D7001	8052 AH
D7002	HEF 4053
D7003	74HCT259
D7004	DQ0044
D7006	74LS244
N7001	LM339

Figure 10.6 Circuit diagram of front unit


X7001
DLENA D7003/6
DLENB D7003/5
DLENTB1 D7003/9
DLENTB2 D7003/11
DLENTB3 D7003/10
FRONT CONTROLS
+10VREF
R7005 10K
VAR A
C7011 10n
R7007 10K
VAR B
C7012 10n
R7009 10K
VAR MTB
C7013 10n
R7006 10K
POS A
R7008 10K
POS B
R7012 1.1K
LEVEL MTB
C7017 10n
R7010 10K
POS X
C7019 10n
R7011 10K
HOLD OFF
REF
N7001 COMP
R7032 15K
R7033 5K11
C7007 100n
D7004
D7006
EN1
REMRQN
TESTOUT
FOOTN
NOPTION
AD1
AD3
AD5
AD7
AD6
AD4
AD2
AD0
STATUS INPUT
BE INDICATOR
X2001 X2009
PRE AMPL A2
CABLE A109
X1009
DLENA
DLENB D1104/4
ATTENUTOR A1
X4001
DLENTB1 D4001/5
DLENTB2 D4002/5
DLENTB3 D4401/2
TIME BASE A4
VAR A R1004
VAR B R1114
VARMTB R4103
POS A R2201
POS B R2206
LEVEL MTB R2369
POS X R4722
HOLD OFF R4301
TRACE SEP R2217
VERTIIC D2601/11
DLENP D2604/5
SDA D2601/13
SCL D2601/3
VERTIIC D7001/11
DLENP D7003/7
SDA D7002/5
SCL D7002/12
CABLE A101
+5V
+5B
R7034 162Ω
R7036 2K5
R7037 1K
C7008 680p
C7009 100n
R7038 1M
GNDD
VCPCF
OSCPCF
X7011
X8011
GND D
VCPCF D8001/35
OSCPCF D8001/37
LCD A8
L7101 15µH
C7100 10n
C7102 220n
C7104 68µ
C7103 10n
C7106 68µ
R7102 100E
+5D
+5A
+17V
+17A
X7012
X8012
D7002/3 SDALCD
D7002/13 SCLLCD
-12V
SDALCD D8001/40
SCLLCD D8001/39
H8001
MAT 3188
880212

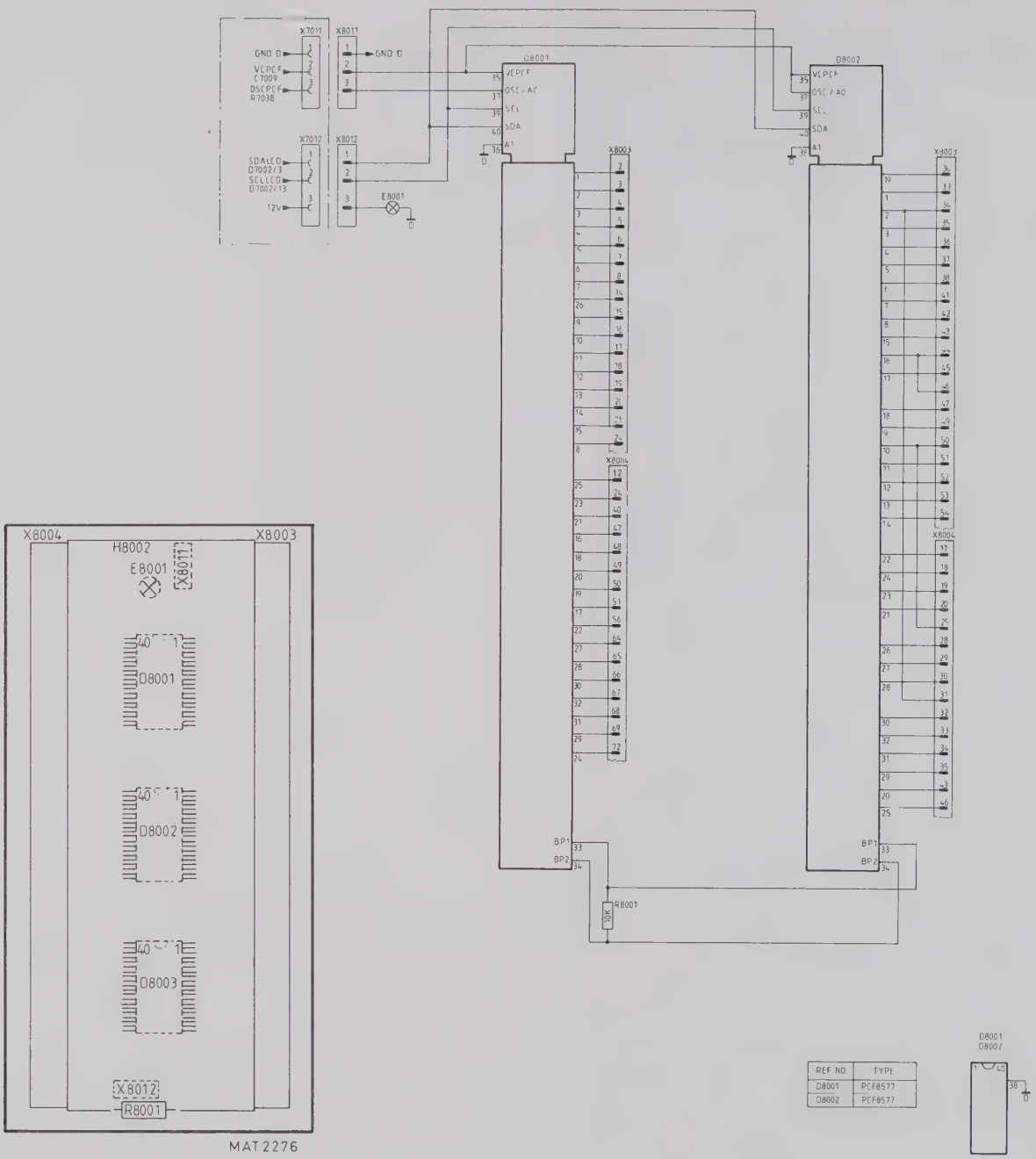
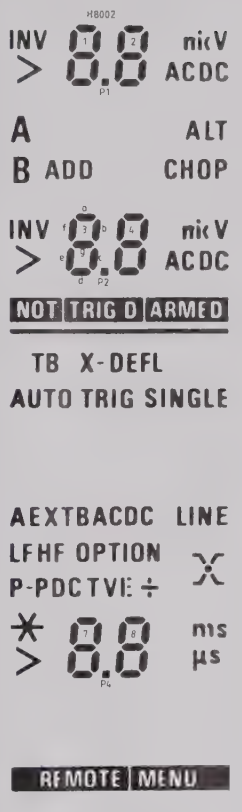


Figure 10.7 LCD unit p.c.b.

X8004

PIN	COM1 DISPLAY/SEGMENT	CH	COM2 DISPLAY/SEGMENT	CH
73				
72	>	A	NV	
71	NC		NC	
70	NC		NC	
69	1 a	A	1 f	A
68	1 g	A	1 e	A
67	1 c	A	1 d	A
66	1 b	A	P1	A
65			A	
64	ADC		B	
63	NC		NC	
62	NC		NC	
61	NC		NC	
60	NC		NC	
59	NC		NC	
58	NC		NC	
57	NC		NC	
56	>	B	NV	B
55	NC		NC	
54	NC		NC	
53	NC		NC	
52	NC		NC	
51	3 a	B	3 f	B
50	3 g	B	3 e	B
49	3 c	B	3 d	B
48	3 b	B	P2	B
47	TRIG'D		NOT	
46	XDEFL		TB	
45				
44	NC		NC	
43	TRIG		AUTO	
42	NC		NC	
41	NC		NC	
40				
39	NC		NC	
38	NC		NC	
37	NC		NC	
36	NC		NC	
35				
34				
33				
32				
31			EXT	
30	B		A	
29	HF		LF	
28	DC		P-P	
27	NC			
26	NC			
25			*	TB
24			>	TB
23	NC		NC	
22	NC		NC	
21	NC		NC	
20	7 a	TB	7 f	TB
19	7 g	TB	7 e	TB
18	7 c	TB	7 d	TB
17	7 b	TB	P4	TB
16				
15				
14				
13				
12				
11				
10				
9				
8				
7				
6				
5				
4				
3				
2				
1	NC		NC	



X8003

PIN	COM1 DISPLAY / SEGMENT	CH	COM2 DISPLAY / SEGMENT	CH
1				
2	2 a	A	2 f	A
3	2 b	A		
4	2 g	A	2 e	A
5	2 c	A	2 d	A
6	rf	A	⌐	A
7	V	A	⌐<	A
8	DC	A	A	A
9	NC		NC	
10	NC		NC	
11	NC		NC	
12	NC		NC	
13	NC		NC	
14	CHOP		ALT	
15	4 a	B	4 f	B
16	4 b	B		
17	4 g	B	4 e	B
18	4 c	B	4 d	B
19	π	B	⌐	B
20	V	B	⌐<	B
21	DC	B	AC	B
22	NC		NC	
23	NC		NC	
24	ARMED			
25	NC		NC	
26	NC		NC	
27	NC		NC	
28	NC		NC	
29				
30	SCALE			
31	N		NC	
32	NC		NC	
33				
34				
35				
36				
37				
38				
39	NC		NC	
40	NC		NC	
41	DC		AC	
42	OPTION		TVI	
43	LINE		—	
44	\			
45	/		•	
46				
47				
48	NC		NC	
49	8 c	TB	8 f	TB
50	8 b	TB		
51	8 g	TB	8 e	TB
52	8 c	TB	8 d	TB
53	?	TB	n	TB
54	s	TB	µs	TB
55	NC		NC	
56	NC		NC	
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73	NC		NC	

MAT2289

Figure 10.8 Circuit diagram of LCD unit

11. PERFORMANCE CHECK

11.1 GENERAL INFORMATION

WARNING: Before switching-on, ensure that the instrument has been installed in accordance with the Installation Instructions outlined in section 2 of the Operating Manual.

This procedure is intended to:

- Check the instruments' specification.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and/or recently recalibrated instrument.
- Check the necessity of recalibration after the specified recalibration intervals.

NOTE: The procedure does not check every facet of the instruments calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instruments covers is not necessary to perform this procedure. All checks are made from the outside of the instrument.

If the test is started within a short period after switching-on, bear in mind that steps may be out of specification, due to insufficient warming-up time.

Warming-up time under average conditions is 30 minutes.

The performance checks are made with a stable, well-focussed, low-intensity display. Unless otherwise noted, adjust the intensity and trigger-level controls as needed.

IMPORTANT NOTES:

* At the start of every check, the controls always occupy the preliminary settings AUTO SET position, unless otherwise stated.

* The input voltage has to be supplied to the A-input; unless otherwise stated.
  Set the TIME/DIV switch to a suitable position; unless otherwise stated.

* Tolerances given are for the instrument under test and do not include test equipment error.

* In this chapter in some checks channel B is mentioned between brackets behind channel A. It is advised to perform first channel A checks. After that the checks for channel B can be done.

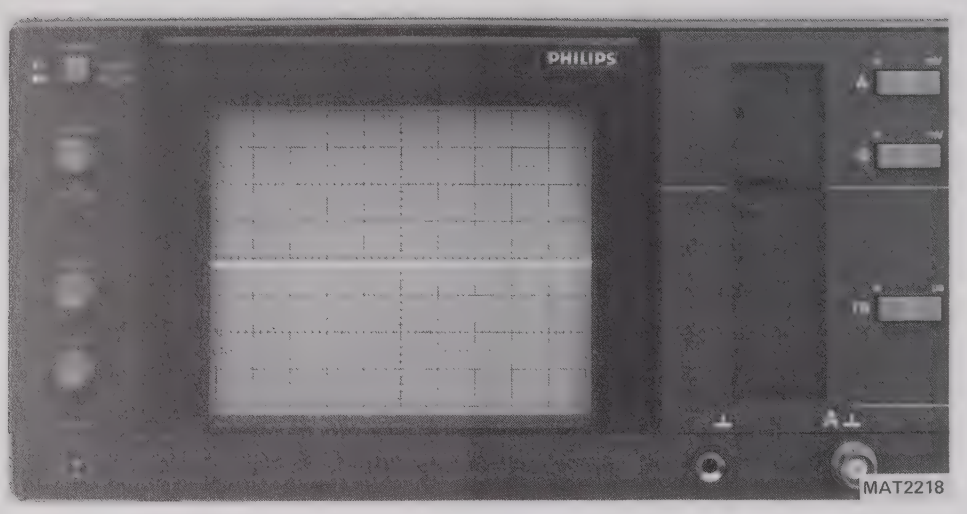


Figure 11.1 SOFTSTART condition

11.2 PRELIMINARY SETTINGS

- Switch-on the instrument (no input signal).
- Check if all LCD segments are on for approx. 1 sec.
- Press MENU and AUTO SET.
- Check if the frontcontrols are set in sequence in the softstart condition as indicated in figure 2.1.
- At the start of every check only AUTO SET must be pressed (after the input signal is applied).

11.3 RECOMMENDED TEST EQUIPMENT

The test equipment that must be used for this performance check is as given in section 13.2 of the Service manual, except:

Trimming tool kit
Oscilloscope
Digital multimeter

11.4 CHECKING PROCEDURE

11.4.1 POWER SUPPLY (characteristics: 2.5)

*	SUBJECT	Line voltage input
	TEST EQUIPMENT	Variable mains transformer
	MAINS VOLTAGE	Between 100 V and 240 V ac (r.m.s.) Frequency: 50 Hz...400 Hz
	SETTINGS	- Press POWER ON - Apply CAL signal to input A - Press AUTO SET
	REQUIREMENTS	- Starts at any mains voltage between 100 V...240 Vac (r.m.s.) - Instruments performance does not change over indicated mains voltage range; displayed CAL signal distortion-free and with equal intensity.
	MEASURING RESULTS	.....
*	SUBJECT	Power Consumption
	TEST EQUIPMENT	Wattmeter (moving iron meter)
	MAINS VOLTAGE	Mains voltage 220 V (r.m.s.).
	SETTINGS	Press POWER ON
	REQUIREMENTS	Consumes : 45 W
	MEASURING RESULTS	.....

11.4.2 DISPLAY (characteristics section 2.1)

*	SUBJECT	Orthogonality
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine-wave signal 50 Hz...60 Hz
	SETTINGS	- Set trace exactly in parallel with horizontal graticule line (see section: Trace rotation) - Apply a sine wave signal to input A. (50 Hz...60 Hz) - Set trace height to 8 div. - Press X DEFL. - Press TRIG or X SOURCE and select B as trigger source
	REQUIREMENTS	- Check if vertical line is in parallel with the vertical graticule line in the centre of the screen. - Angle with respect to horizontal line must be 90^{o} +or- 1^{o}
	MEASURING RESULTS	.....

*	SUBJECT	LCD check
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Press MENU and keep it pressed - Then press AUTO SET - Check if LCD indicates "1°", "2°", "AS" and "3°" - Press "S" of TB UP-DOWN control - Press MENU, 8 times - All segments of the LCD should be ON according to figure 3.2 of the operating manual. - To leave this test: press MENU and then AUTO SET
	REQUIREMENTS	- Check if all segments of the LCD are on (see figure 3.2 of the Operating manual)
	MEASURING RESULTS	.....

11.4.3 VERTICAL DEFLECTION OR Y-AXIS (characteristics section 2.2)

---

*	SUBJECT	Vertical Deflection
	TEST EQUIPMENT	LF Square wave generator
	INPUT VOLTAGE	Square wave signal 1 kHz to A
	SETTINGS AND REQUIREMENTS	- Set trace height to 5 div. - Check if one square wave signal of 5 div. is displayed. - Press A/B; channel A and B on - Check if a square wave signal (A) and a zero trace (B) is displayed and if A and B are on. - Press ALT/CHOP - Check if ALT or CHOP is active.
	INPUT VOLTAGE	Square wave signal 1 kHz to input A and B
	SETTINGS AND REQUIREMENTS	- Press AUTO SET - Check if A, B and ALT are on - Set trace height to 4 div. - Press AC/DC of channel A and B for DC input coupling - Press ADD/INVERT twice for ADD mode. - Check if 3 square wave signals are displayed: channels A and B each 4 div. trace height and A+B with 8 div. trace height. - Press ADD/INVERT once more for ADD and INVERT mode - Check if 2 square waves of 4 div. (A and B) and a line is displayed (A-B)
	MEASURING RESULTS	.....
*	SUBJECT	Vertical Deflection coefficients and input coupling of Channels A and B (characteristics section 2.2.1)
	TEST EQUIPMENT	Square-wave calibration generator (PG506)
	INPUT VOLTAGE	Square-wave signal 1 kHz to input A(B), amplitude 10 mVpp...20 Vpp in 1-2-5 steps

SETTINGS AND REQUIREMENTS
- Apply a 1 kHz square wave signal of 10 mV to input A(B)
- Set A (B) to 2 mV/div.
- Check if the amplitude of the signal is 5 div. (+or- 3%)
- Increase the input amplitude and vertical sensitivity with the following steps:

Input voltage (pp)	A (B) setting	Requirements	Measuring results
10 mV	2 mV	5 div.(+or-3%)	.....
20 mV	5 mV	4 div.(+or-3%)	.....
50 mV	10 mV	5 div.(+or-3%)	.....
0,1 V	20 mV	5 div.(+or-3%)	.....
0,2 V	50 mV	4 div.(+or-3%)	.....
0,5 V	100 mV	5 div.(+or-3%)	.....
1 V	200 mV	5 div.(+or-3%)	.....
2 V	500 mV	4 div.(+or-3%)	.....
5 V	1 V	5 div.(+or-3%)	.....
10 V	2 V	5 div.(+or-3%)	.....
20 V	5 V	4 div.(+or-3%)	.....
50 V	10 V	5 div.(+or-3%)	.....

* SUBJECT — Variable gain control range (continued procedure of previous subject)

SETTING — Turn VAR control fully anti-clockwise

REQUIREMENTS — Check if displayed amplitude <2 div. (1:>2,5)

MEASURING RESULTS .....

* SUBJECT — Input coupling (continued procedure of previous subject)

SETTINGS AND REQUIREMENTS
- Turn VAR control fully clockwise.
- Press "GND"; check if input signal is interrupted
- Press "GND" again and then AC/DC
- Check if in DC position the signal shifts upwards

MEASURING RESULTS .....

* SUBJECT — Frequency response

TEST EQUIPMENT — Constant amplitude sine-wave generator (SG503)

INPUT VOLTAGE — Constant amplitude sine-wave signal, 120 mV frequency 50 kHz...50 MHz to input A (B).

SETTINGS AND REQUIREMENTS
- Set A (B) to 20 mV/div.
- Apply 50 kHz sine-wave signal to A (B)
- Adjust trace height to exactly 6 div.
- Increase the frequency of the input signal up to 60 MHz.
- Check if the vertical deflection is > 4,2 div. (-3 dB) over the complete bandwidth range (>60 MHz).
- Reduce the amplitude of the input signal to 12 mV and the frequency to 50 kHz.
- Set A (B) to 2 mV.
- Adjust the trace height to exactly 6 div.
- Increase the frequency up to 35 MHz.
- Check if the vertical deflection is > 4,2 div. (-3 dB) over the complete bandwidth range (>35 MHz)

MEASURING RESULTS .....

*	SUBJECT	Rise-Time
	IMPORTANT	THE RISE TIME IS A CALCULATED VALUE, ACCORDING FORMULA: BANDWIDTH X RISE-TIME = 0,35
	TEST EQUIPMENT	Fast-rise square-wave generator (PG506)
	INPUT VOLTAGE	Fast-rise square-wave signal $\leq$ 1 ns to input A (B) frequency: 1MHz.
	SETTINGS	- Set A(B) to 50 mV/div. - Press TB MAGN - Set TB to 5 ns/div. - Adjust the trace height exactly between the dotted lines 0% and 100% (5 div.)
	REQUIREMENTS	Important: $T_R(\text{measured}) = \sqrt{T_R(\text{input signal})^2 + T_R(\text{oscilloscope})^2}$ - Check the rise-time, measured between the 10% and 90% lines (4 div.); * rise-time must be: 5,8 ns or less (approx. 1,2 div. or less).
	MEASURING RESULTS	.....
*	SUBJECT	Pulse response
	TEST EQUIPMENT	Fast-rise square-wave generator (PG506)
	INPUT VOLTAGE	Fast-rise square-wave signal ($\leq$ 1 ns) to input A (B)
	SETTINGS AND REQUIREMENTS	NOTE: Take the pulse distortion of the calibration generator (2%) into account when performing the now following calibration steps. The pulse response of the signal at the output of the generator is optimal with max. pulse amplitude. - The required fast rise-time square-wave must be obtained from the square-wave generator. - Adjust channel A (B) to an input sensitivity of 20 mV/div. - Select DC input coupling for channel A (B) - Apply a 1 MHz/5 div. (+ and - 2,5 div) square-wave signal with a rise-time of 1 ns to input A (B) - Set TB to 50 ns/div. - Press TB MAGN on. - Check the pulse response; * Overshoot, ringing and rounding: <1,5 subdiv. p-p * Duration of ringing: 20 ns (ringing must be ended when amplitude is 1/3 of starting amplitude * Hole or bump: <0,7 subdiv (peak) * Drop or tilt: <0,7 subdiv (peak)
	MEASURING RESULTS	.....

*	SUBJECT	Noise
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Press A/B: channel A and B on - Set channel A and B to 20 mV/div - Press ALT/CHOP for CHOP mode - Press GND of both channels for grounded input coupling
	REQUIREMENT	- Check if the traces are not thicker than 0,5 subdiv.
	MEASURING RESULTS	.....
*	SUBJECT	Vertical Dynamic range
	TEST EQUIPMENT	Constant amplitude sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 1 MHz, 2,4 Vpp to input A(B)
	SETTINGS	- Apply sine-wave signal of 1 MHz, 2,4 Vpp to input A(B). - Set A (B) to 100 mV/div. - Shift with the Y POS control the sine-wave vertically over the screen.
	REQUIREMENT	- Check if the top and bottom of the sine-wave signal can be displayed distortion-free (24 div. trace height).
	INPUT VOLTAGE	Sine-wave signal of 50 MHz, 1,6 Vpp to input A(B)
	SETTINGS	- Set A (B) to 200 mV/div. - Set the trace height to exactly 8 div. - Increase the frequency of the input signal up to 50 MHz
	REQUIREMENT	- Check if a sine-wave signal of 8 div. is displayed distortion-free.
	MEASURING RESULTS	.....
*	SUBJECT	Position range (vertical)
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 1 kHz, 8 V to input A(B)
	SETTINGS	- Set the channel A (B) input sensitivity to 1 V/div. - Apply a sine-wave of 1 kHz/8 div. to the channel A (B) input. - Set the channel A (B) input sensitivity to 500 mV/div. - Rotate the channel A (B) Y POS control fully clockwise and anti-clockwise
	REQUIREMENT	- Check if the top and the bottom of the signal can be positioned on the vertical centre line of the screen.
	MEASURING RESULTS	.....

*	SUBJECT	Decoupling factor between channels A and B at 10 MHz
	TEST EQUIPMENT	Sine-wave calibration generator (SG503)
	INPUT VOLTAGE	Sine-wave signal 10 MHz, 4 V to input A(B)
	SETTINGS	- Set channel A and B to 0,5 V/div. - Apply sine-wave input signal to input A(B) - Set the trace height to 8 div. - Press A/B (channel with input signal off).
	REQUIREMENTS	- Check if trace height of channel without input signal B(A) is < 0,08 div. (1:>100)
	MEASURING RESULTS	.....
*	SUBJECT	Decoupling factor between channels A and B at 50 MHz
	TEST EQUIPMENT	HF sine-wave generator (SG503)
	INPUT VOLTAGE	50 MHz sine-wave signal, 4 V to input A(B)
	SETTINGS	- Do the same settings as indicated above
	REQUIREMENTS	- Check if trace height of channel without input signal B(A) is <0,16 div. (1:>50)
	MEASURING RESULTS	.....
*	SUBJECT	Common Mode Rejection Ratio
	TEST EQUIPMENT	HF constant Amplitude sine-wave generator (SG503)
	INPUT VOLTAGE	Sine wave signal 1 MHz, 4 Vpp to inputs A and B
	SETTINGS	- Set A and B to 500 mV/div. (8 div.) - Set input coupling of channels A and B to DC - Press ADD/INVERT three times (ADD and INVERT on) - Adjust one VAR control (A or B) for minimum trace height difference of channel A and B
	REQUIREMENT	- Check if the trace height of the A-B signal is < 0,08 div.
	MEASURING RESULTS	.....
*	SUBJECT	LF linearity (vertical)
	TEST EQUIPMENT	LF square-wave generator
	INPUT VOLTAGE	Square-wave signal 50 kHz, 200 mV to input A(B)
	SETTINGS	- Set A (B) to 100 mV/div. - Set the square-wave signal in the vertical centre of the screen. - Adjust the square-wave signal to exactly 2 div. trace height. - Shift the signal with the Y POS control to the two upper and lower div. of the screen.
	REQUIREMENT	- Check if the trace height in the two upper and lower div. is 2 div. (max. ampl. deviation must be <3%)
	MEASURING RESULTS	.....

* SUBJECT — Visual Signal Delay

TEST EQUIPMENT — Square wave calibration generator (PG506)

INPUT VOLTAGE — Fast-rise input signal 1 MHz, ≤1 ns, 0,5 V to input A

SETTINGS
- Apply fast-rise input signal to input A
- Set A to 100 mV/div.
- Set MAIN TB to 50 ns/div.
- Press TB MAGN and turn X POS
- Set INTENSITY fully clock-wise
- Set trigger coupling to DC and adjust with LEVEL for maximum visual signal delay

REQUIREMENT
- Check if visual signal delay is >15 ns

MEASURING RESULTS .....

* SUBJECT — Base line jump

TEST EQUIPMENT -

INPUT VOLTAGE -

SETTINGS

Attenuator balance

- This check must be done in the SERVICE MENU "1". To enter this menu proceed as follows:
- Press MENU and keep it pressed and then press AUTO SET
- Press V of channel A UP-DOWN control
- Check LCD display: "1.0" flashing
- The attenuator is now switched between the 1-2-5 positions
- Check if the base line do not jump more than 1,5 subdiv.

VAR balance

- Press MENU; "1.1" flashing in LCD
- Rotate VAR control of channel A and B
- Check if the base lines do not jump more than 1 subdiv.

X1/X10 attenuator offset

- Press MENU; "1.2" flashing in LCD
- Check if the base lines do not jump more than 1 subdiv.

NORMAL-INVERT jump

- Press MENU four times; "1.6" flashing in LCD
- Check if the displayed point does not jump more than 1 subdiv.
- Press AUTO SET two times to leave the SERVICE MENU

MEASURING RESULTS .....

11.4.4		HORIZONTAL DEFLECTION OR X-AXIS (characteristics section 2.3)
*	SUBJECT	OFFSET of trigger point
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS AND REQUIREMENT	- This check must be done in the SERVICE MENU "1°". To enter this menu proceed as follows: - Press MENU and keep it pressed and then press AUTO SET - Press V of channel A UP-DOWN control - Press MENU three times; "1.3" in LCD flashing - Turn Y POS of channel B and set the point in vertical centre of the screen. - Check if the displayed point does not jump more than 1,5 subdiv horizontally - Press MENU; "1.4" in LCD flashing - Turn Y POS of A and set point in the vertical centre - Check if the displayed point does not jump more than 1,5 subdiv. horizontally - Press MENU; "1.5" in LCD flashing - Turn Y POS of B and set point in vertical centre - Check if the displayed point does not jump more than 1,5 subdiv. - Press AUTO SET two times to leave the SERVICE MENU
	MEASURING RESULTS	.....
*	SUBJECT	X Deflection
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine wave signal 2 kHz, 3 div. trace height to input A
	SETTINGS AND REQUIREMENTS	- Press AUTO SET - Set the trace height to 3 div. - Press X DEFL - Check if only X DEFL is on - Select A of trigger source - Check if a line under an angle of 45° is displayed.
	MEASURING RESULTS	.....
*	SUBJECT	Deflection coefficient
	TEST EQUIPMENT	Time marker generator (TG501)
	INPUT VOLTAGE	Time marker signal 50 ns...0,5 s
	SETTINGS	- Apply a time marker signal of 50 ns to input A - Press AUTO SET

REQUIREMENT - Check the deflection coefficients in TB X1 and TB X10 according the table below:

Time marker pulse	TB setting ../div	Max. coeff. error TB X1	Max. coeff. error TB X10 TB MAGN on	Measuring results
50 ns	50 ns	3%	4%	.....
0,1 us	0,1 us	3%	4%	.....
0,2 us	0,2 us	3%	4%	.....
0,5 us	0,5 us	3%	4%	.....
1 us	1 us	3%	4%	.....
2 us	2 us	3%	4%	.....
5 us	5 us	3%	4%	.....
10 us	10 us	3%	4%	.....
20 us	20 us	3%	4%	.....
50 us	50 us	3%	4%	.....
0,1 ms	0,1 ms	3%	4%	.....
0,2 ms	0,2 ms	3%	4%	.....
0,5 ms	0,5 ms	3%	4%	.....
1 ms	1 ms	3%	4%	.....
2 ms	2 ms	3%	4%	.....
5 ms	5 ms	3%	4%	.....
10 ms	10 ms	3%	4%	.....
20 ms	20 ms	3%	4%	.....
50 ms	50 ms	3%	4%	.....
0,1 s	0,1 s	3%	4%	.....
0,2 s	0,2 s	3%	4%	.....
0,5 s	0,5 s	3%	4%	.....

* SUBJECT — Variable control ratio (VAR TB) and TB Magnifier balance

TEST EQUIPMENT — Time marker generator (TG501)

INPUT VOLTAGE — Time marker signal 1 us to input A

SETTINGS
- Set TB to 0,2 us/div; marker on first and sixth graticule line
- Set the TB VAR fully anti-clockwise

REQUIREMENT
- Check if the VAR control range overlaps the time base steps 0,2 us to 0,5 us; first marker on first graticule line and second marker on the third graticule line or closer to the first marker (2,5:1)

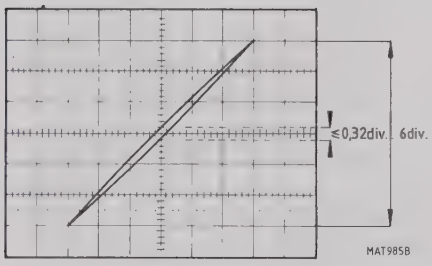
SETTINGS
- Set the TB VAR control fully clockwise
- Press TB MAGN (on)
- Set the top of the second marker pulse exactly in the vertical centre of the graticule
- Press TB MAGN (off)

REQUIREMENT
- Check if the top of the second marker pulse is not shifted more than 2,5 subdiv.

MEASURING RESULTS .....

*	SUBJECT	Horizontal Deflection coefficients
	TEST EQUIPMENT	Sine wave generator
	INPUT VOLTAGE	Sine wave signal 2 kHz, 4 div. trace height to input A
	SETTINGS	- Press EXT X DEFL - Press A/B twice for only ch. B display - Select A as X DEFL source with TRIG or X SOURCE
	REQUIREMENT	- Check if a horizontal line of 4 div. is displayed (+or- 5%).
	INPUT VOLTAGE	- Sine wave signal 2 kHz, 1 V to input EXT
	SETTINGS AND REQUIREMENTS	- Select EXT with TRIG or X SOURCE - Press X DEFL - Check if a horizontal line of 10 div. (+or- 5%) is displayed. - Select LINE with TRIG or X SOURCE - Check if a horizontal line is displayed of approx 6 div. (at 220 V mains voltage)
	MEASURING RESULTS	.....
*	SUBJECT	Frequency response (horizontal)
	TEST EQUIPMENT	Constant amplitude sine-wave generator (PG506)
	INPUT VOLTAGE	Constant amplitude sine-wave signal, 30 mV, 50 kHz...2 MHz to input A
	SETTINGS	- Set A to 5 mV/div - Apply a 50 kHz sine-wave signal to input A - Adjust the trace height to exactly 6 div. - Press X DEFL - Select A as horizontal deflection source with TRIG or X SOURCE - Adjust the input voltage for exactly 6 div. horizontal deflection - Increase the frequency of the input signal up to 2 MHz
	REQUIREMENTS	- Check if the trace width is > 4,2 div. (-3 dB) over the complete bandwidth range.
	MEASURING RESULTS	.....
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal, 10 Hz, 6 div. trace height to input A
	SETTINGS	- Set the vertical deflection of A to exactly 6 div. - Select X DEFL and A as X DEFL source - Decrease the frequency of the input signal.
	REQUIREMENT	- Check if the frequency of the input signal is much lower than 10 Hz at a trace width of 4,2 div.
	MEASURING RESULTS	.....

*	SUBJECT	Maximum phase shift between horizontal and vertical deflection.
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine wave signal, 2 kHz...100 kHz, trace height 6 div.
	SETTINGS	- Press X DEFL - Select A for horizontal deflection with TRIG or X SOURCE - Set the trace height to exactly 6 div. - Increase the input frequency up to 100 kHz.
	REQUIREMENT	- Check if the phase shift < 3^{o} (see fig. below)



MEASURING RESULTS .....

11.4.5 TRIGGERING (characteristics, section 2.4)

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*	SUBJECT	Trigger Sources and trigger coupling
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal 2 kHz, 4 div. trace height to input A (EXT)
	SETTINGS AND REQUIREMENTS	- Set the trace height to 4 div. - Press TRIG COUPL and select DC - Adjust LEVEL for a triggered signal - Check if a square wave signal is displayed of 4 div. - Press TRIG COUPL and select p-p - Turn LEVEL and check if the signal is triggered over the complete level range. - Connect CAL signal to input B - Set B to 200 mV. - Select B as trigger source with TRIG or X SOURCE (A is not triggered) - Check if a square wave of 6 div. is displayed - Increase the freq. of the square-wave signal to input A up to 20 kHz (CAL signal to B) - Press TRIG or X SOURCE four times (A and B selected.) - Check if two well triggered traces are displayed. - Remove input signals
	MEASURING RESULTS	.....

*	SUBJECT	Slope selection and Level control range.
	TEST EQUIPMENT	LF Sine-wave generator
	INPUT VOLTAGE	Sine-wave signal 2 kHz - 800 mV to input A(B) (EXT)
	SETTINGS AND REQUIREMENTS	- Set A(B) to 0,1 V/div (DC input coupling) - Press TRIG COUPL for p-p triggering - Turn LEVEL fully clockwise and fully anti-clockwise - Check if the signal is well triggered over the complete LEVEL range - Set the LEVEL control in its mid-position - Start of signal display must be in the vertical centre - Press TB TRIG (TRIG mode) - Press SLOPE - Check if the sine-wave signal is inverted and is triggered on the negative slope. - Press SLOPE once again - Set A(B) to 50 mV/div (16 div. trace height) - Turn the LEVEL - Check if the LEVEL range is > +or- 8 div. and if the signal is triggered on the positive slope. - Set A(B) to 0,1 V/div - Check if NOT TRIG'D is on, if the LEVEL control is set in its extreme positions - Remove input signal
	MEASURING RESULTS	.....
*	SUBJECT	Trigger Sensitivity
	TEST EQUIPMENT	Sine-wave generator (SG503)
	INPUT VOLTAGE	Sine-wave signal 10 MHz-(50 MHz)-(100 MHz) to input A (B) (EXT)
	SETTINGS AND REQUIREMENTS	- Press AC/DC (input coupling of A(B) to DC) - Press TB TRIG MODE for TRIG mode - Press TRIG COUPL for DC trigger coupling - Apply a sine-wave signal of 10 MHz approx. 250 mVpp to input A(B) - Set A(B) to 0,2 V/div. - Decrease amplitude of input signal - Turn LEVEL - Check if the signal is well-triggered at amplitudes $\geq$ 0,5 div. - Decrease the frequency of the input signal to 50 kHz - Check if the signal stays well triggered at amplitudes $\geq$0,5 div. - Increase the frequency of the input signal up to 50 MHz. - Decrease amplitude of input signal to approx 1 div. - Turn LEVEL - Check if the signal is well-triggered at amplitudes $\geq$ 1 div. - Increase the frequency of the input signal up to 100 MHz

		- Decrease amplitude to approx 3 div. - Check if the signal is well-triggered at amplitudes ≥ 3 div. - Remove input signal
	MEASURING RESULTS	.....
*	SUBJECT	Trigger sensitivity TVL-TVF
	TEST EQUIPMENT	TV pattern generator with video output (PM5518)
	INPUT VOLTAGE	Video signal to input A (B)
	SETTINGS	- Press TB TRIG mode for TRIG mode - Press AC/DC for DC input coupling - Apply a video signal to input A(B) with an amplitude of 0,7 div. sync. pulse amplitude - Press TRIG COUPL for TVL and TVF
	REQUIREMENTS	- Check for a stable triggering on TVL and TVF at sync. amplitudes of >0,7 div.
	MEASURING RESULTS	.....

11.4.6 AUXILIARY INPUTS AND OUTPUTS

*	SUBJECT	Z-MOD Sensitivity
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal, 1 kHz, duty cycle 50%, amplitude 0...5 Vpp to input A and Z-in (rear side)
	SETTINGS AND REQUIREMENTS	- Set TB to 0,5 ms/div. - Set the trace of A in mid-position - Select DC for channel A Input coupling - Apply square-wave signal of 2,5 Vpp, 1 kHz to input A and Z-MOD input. (base line 0 V) - Check if only the bottom half of the square wave signal is displayed (500 us blanking and 500 us unblanking) - Decrease the amplitude of the input signal to 1 Vpp. - Set A to 0,5 V/div. - Check if the top half of the square-wave signal is visible with a lower intensity and will be completely unblanked at an input voltage of < 0,8 V
	MEASURING RESULTS	.....
*	SUBJECT	CAL Frequency and output voltage
	TEST EQUIPMENT	-
	INPUT VOLTAGE	CAL output signal to input A
	SETTINGS	- Press 0 of channel A - Set the trace in the centre of the screen - Press 0 of channel A - Select DC of A input coupling
	REQUIREMENTS	- Check if a positive going square wave signal is displayed of 1,2Vpp, frequency 2 kHz
	MEASURING RESULTS	.....

12. DISMANTLING THE INSTRUMENT

12.1 GENERAL INFORMATION

This section provides the dismantling procedures required for the removal of components during repair operations.
All circuit boards removed from the instrument must be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During the dismantling a careful note must be made of all disconnected leads so that they can be reconnected to their correct terminals during assembly.

CAUTION: Damage may result if:

- The instrument is switched-on when a circuit board has been removed.
- a circuit board is removed within one minute after switching-off the instrument.

12.2 REMOVING THE TOP AND BOTTOM COVERS

The instrument is protected by two covers: a top cover and a bottom cover. To remove these covers, proceed as follows:

- Slacken the two screws that secure both covers, located at the rear of the instrument.
- Gently push each cover backwards until it can be lifted.
- The covers can be removed by lifting them clear of the instrument.

12.3 ACCESS TO PARTS FOR THE CHECKING AND ADJUSTING PROCEDURES

After removing both covers (section 12.2) almost all adjustment and measuring points are accessible. However, for access to the adjusting elements of the time-base unit and the pre-amplifier unit first loosen the upper time-base unit and vertically fix this unit in the available p.c.b. guide fixing.

If necessary, the power supply unit can be lifted out of the instrument. To do so, proceed as follows:

- Push both parts at the back of the extension shaft towards each other so that the extension shaft can easily be loosened from the ON/OFF switch on the power supply unit.
- Remove the complete extension shaft.
- Push both lips that secure the power supply unit sidewards and gently lift this unit out of the instrument.
- Fix the power supply unit in the available p.c.b. guide fixing.

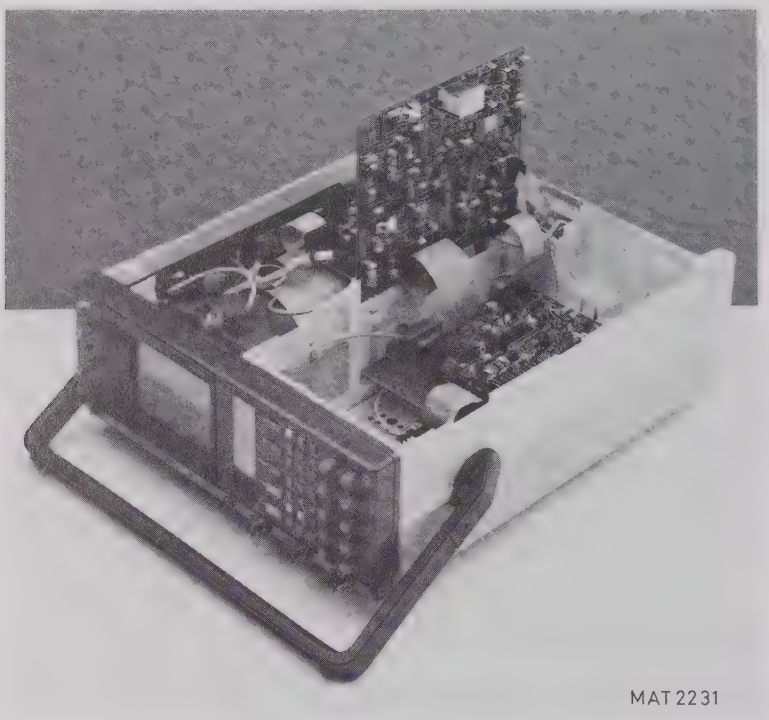


Figure 12.1 Access to all parts for checking and adjusting

NOTE: For checking and adjusting the instrument it is not necessary to remove the bottom cover.

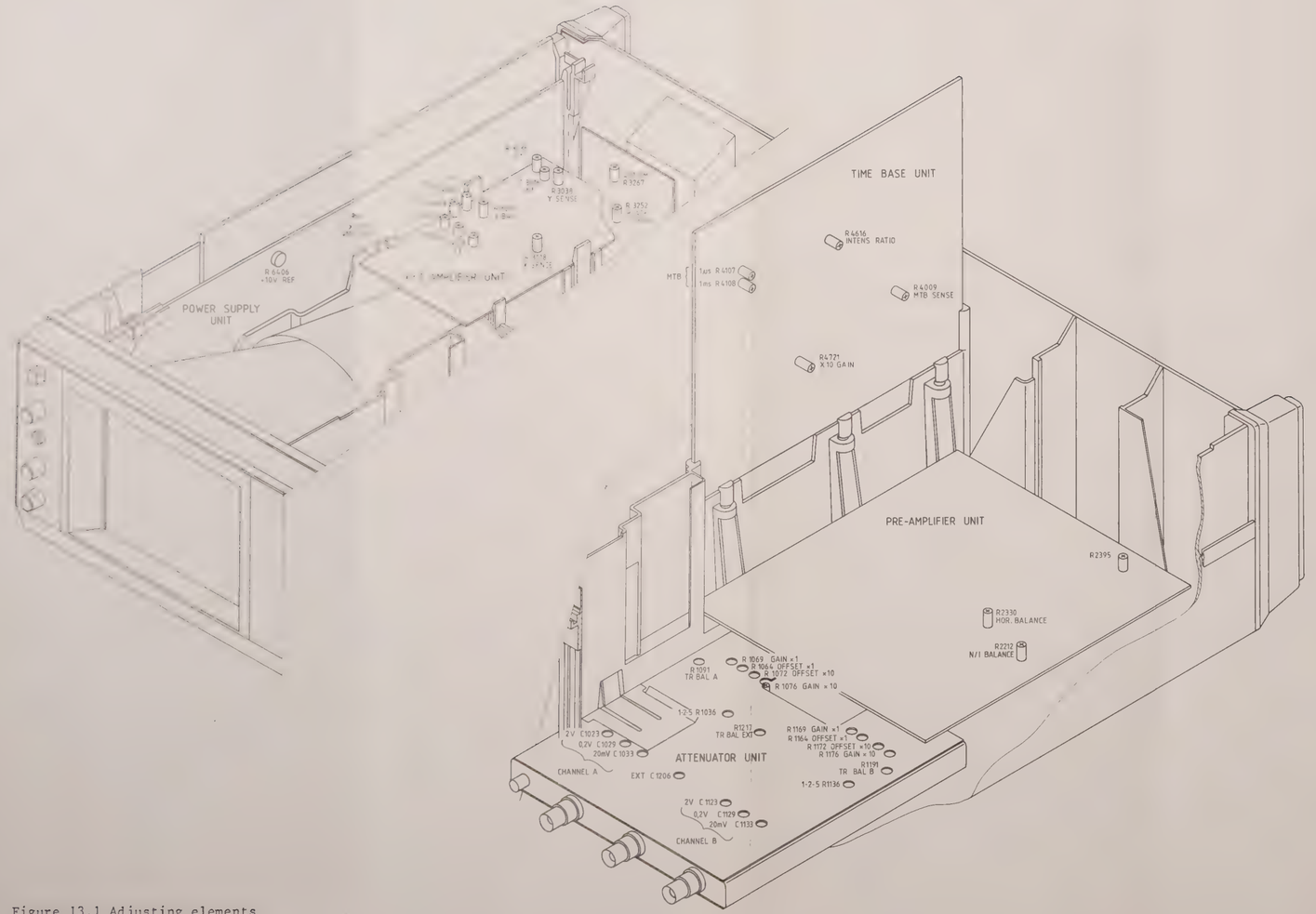
13. CHECKING AND ADJUSTING

13.1 GENERAL INFORMATION

The following information provides the complete checking and adjusting procedure for the instrument. As various control functions are interdependent, a certain order of adjustment is necessary.
The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Warming-up time under average conditions is 30 minutes.
- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this section are calibration guides, and should not be interpreted as instrument specifications unless they are also published in section 2.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focused low intensity display.
- All controls that are mentioned without item numbers are located on the outside of the instrument.

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by qualified person who is aware of the hazard involved.



MAT2293A
880212

Figure 13.1 Adjusting elements

13.2 RECOMMENDED TEST AND CALIBRATION EQUIPMENT

Type of instrument	Required specification	Example of recommended instrument
Function generator	Freq.: 1 MHz ... 10 MHz Sine-wave/Square-wave Ampl.0...20 Vpp DC offset 0...±5 V Rise-time <30 ns Duty cycle 50 %	Philips PM5134
Constant amplitude sine-wave generator	Freq.: 100 kHz ... 50 MHz Constant ampl. of 120 mVpp and 3 Vpp	Tektronix SG 503
Square-wave calibration generator	For ampl. calibration: Freq.: 1 kHz Ampl.: 10 mV ... 50 V For rise-time measurements: Freq.: 1 MHz Ampl.: 10 mV ... 500 mV Rise-time: ≤1 ns	Tektronix PG 506
Time-marker generator	Repetition rate: 0,5 s ... 0,05 /us	Tektronix TG 501
Digital multimeter	Wide voltage, current and resistance ranges. Required accuracy 0,1 %	Philips PM2524 and high-voltage probe PM9246
Oscilloscope	The bandwidth must be the same or higher than the bandwidth of the instrument under test.	Philips PM3055
Variable mains transformer	Well-insulated output voltage 90...264 Vac	Philips ord.number 2422 529 00005
Moving-iron meter		
Dummy probe 2:1	1 Megohm ±0,1 %//20 pF	
Cables, T-piece, terminations for the generators	General Radio types for fast rise-time square-wave and high freq. sine-wave. BNC-types for other applications	
Trimming tool		Philips 800NTX (ord. kitnumber 4822 310 50015)

13.3 SURVEY OF ADJUSTING ELEMENTS

ADJUSTING ELEMENT	ADJUSTMENT	INPUT SIGNAL	SECTION
R6406	supply voltage +10 VREF	-	13.4.2
R4616	intens ratio	-	13.4.3
R3252	black level	-	13.4.3
R3267	astigmatism	Sine-wave 120 mV-1 kHz	13.4.3
C1033	1.f.square wave response ch.A at 20 mV	square-wave 120 mV - 1 kHz	13.4.4
C1029	1.f.square wave response ch.A at 0,2 V	square-wave 1,2 V - 1 kHz	13.4.4
C1023	1.f. square wave response ch.A at 2 V	sqare-wave 12 V - 1 kHz	13.4.4
C1133	1.f. square wave response ch.B at 20 mV	square-wave 120 mV - 1 kHz	13.4.4
C1129	1.f. square wave response ch.B at 0,2 V	square-wave 1,2 V - 1 kHz	13.4.4
C1123	1.f. square wave response ch.B at 2 V	square-wave 12 V - 1 kHz	13.4.4
C1206	1.f. square wave response EXT	square-wave 600 mV - 1 kHz	13.4.4
R3118	horizontal sensitivity	square-wave 100 mV - 1 kHz	13.4.5
R1069	gain x1 ch.A	square-wave 100 mV - 1 kHz	13.4.6
R3038	vertical sensitivity	square-wave 100 mV - 1 kHz	13.4.6
R1169	gain x1 ch.B	square-wave 100 mV - 1 kHz	13.4.6
R1176	gain x10 ch.B	square-wave 10 mV - 1 kHz	13.4.6
R1076	gain x10 ch.A	square-wave 10 mV - 1 kHz	13.4.6
R1036-R1136	offset ch.A (ch.B)	-	13.4.7
R1064-R1164	offset x1 ch.A (ch.B)	-	13.4.7
R1072-R1172	offset x10 ch.A (ch.B)	-	13.4.7

ADJUSTING ELEMENT	ADJUSTMENT	INPUT SIGNAL	SECTION
R2330	horizontal balance	-	13.4.7
R1091	trigger balance ch.A	-	13.4.7
R1191	trigger balance ch.B	-	13.4.7
R1217	trigger balance EXT	-	13.4.7
R2212	norm/invert balance	-	13.4.7
R3007	vertical balance	-	13.4.7
R4009	sensitivity MTB	Sine-wave 80 mV - 10 kHz	13.4.8
R4108	MTB gain 1 ms	time marker 1 ms	13.4.9
R4107	MTB gain 1 us	time marker 1 us	13.4.9
R4721	gain x10 MAGN	time marker 100 us	13.4.10
R3017	h.f. square-wave response	square-wave 120 mV - 1 MHz rise-time ≤1 ns	13.4.11
R3013			13.4.11
C3007			13.4.11
C3004			13.4.11
C3005			13.4.11
R3036			13.4.11
C3016			13.4.11

13.4 CHECKING AND ADJUSTING PROCEDURE

The adjusting elements and measuring points are given in figure 13.1.

NOTE: Use always an insulated adjustment tool.

13.4.1 Preparation

Before starting the checking and adjusting procedure, it is necessary to be aware of the following.

- Unless otherwise indicated, the time-base must be triggered on the channel that is selected for vertical display and the trigger path is P-P coupled. The time-base must function in the AUTO mode and its sweep speed must be adjusted to give good display of the phenomena of interest. The INTENS and FOCUS control must be adjusted to a well-defined trace display.
- Preliminary setting of the controls:
  All VAR controls must be set in CAL position
  All POS and LEVEL controls must be set in mid-position.
  The HOLD OFF control must be set to MIN position.
- Take care to remove the input voltage after each section.

For better access to the adjusting elements on the time base unit and the power supply unit, proceed as indicated in section 12.3.

ATTENTION: Do not readjust potentiometer R2395, situated on the Pre-amplifier unit. However, if this potentiometer is inadvertently turned, proceed as follows:
- Set R2395 in its mid-position.
- Readjust R4009 according to section 13.4.8.

13.4.2 Power supply adjustment

- Connect the instrument to the mains voltage and switch on the oscilloscope.
- Connect a digital multimeter to connection point X6001 (+10V REF) on the power supply unit and the instrument's ground.
- Adjust R6406 so that the supply voltage is exactly +10 V (tolerance: +or- 0,01 V).

13.4.3 CRT display adjustment

Black level:

- Press X DEFL key
- Set the INTENS control to 10° from its left hand stop.
- Set R4616 in its mid-position
- Adjust R3252 so that the spot is just not visible.

Trace rotation:

- Press X DEFL key again for deflection via time base.
- Adjust the front-panel TRACE ROTATION control so that the trace runs exactly in parallel with the horizontal graticule lines.

Astigmatism:

- Apply a 120 mV/1 kHz sine-wave signal to input A.
- Press AUTO SET key.
- Set the INTENS control for normal brightness.
- Adjust R3267 (and the FOCUS control) so that the trace is sharp and well-defined over the whole screen area.

13.4.4 Square-wave response attenuator

Channels A and B:

The vertical adjustments of channels A and B are identical. The indication for channel B are shown in brackets behind those of channel A. It is advisable to perform first the channel A adjustments in this section.

- Apply a calibrated square-wave signal, frequency 1 kHz to input A (B)
- Press AUTO SET key.
- Press AC/DC key ch.A (ch.B) for DC input coupling.
- Set the adjusting elements for a straight pulse top with a maximum pulse top error of + or - 1,5 % (see table below).

INPUT SIGNAL YA (YB)	UP-DOWN ch.A (ch.B)	Adjusting element
120 mV	20 mV	C1033 (C1133)
1,2 V	0,2 V	C1029 (C1129)
12 V	2 V	C1023 (C1123)

External amplifier:

- Apply a 500 mV/1 kHz calibrated square-wave signal to input EXT.
- Press MENU and AUTO SET for RESTART condition.
- Press X DEFL key
- Press TRIG or X SOURCE key for EXT (DC) source.
- Adjust C1206 so that both spots are well-defined visible.

13.4.5 Adjustment of horizontal sensitivity

- Apply a 500 mV/1 kHz calibrated square-wave signal to input EXT.
- Press MENU and AUTO SET for RESTART condition.
- Press X DEFL key
- Press TRIG or X SOURCE key for EXT (DC) source.
- Adjust R3118 for a trace width of exactly 5 divisions.

13.4.6 Adjustment of vertical sensitivities

Gain X1 adjustment channel A:

- Apply a 100 mV/ 1 kHz calibrated square-wave signal to input A.
- Press AUTO SET key.
- Press AC/DC key ch.A for DC input coupling.
- Press X DEFL key.
- Press A/B key for ch.B selection.
- Set UP-DOWN ch.A to 20 mV.
- Adjust R1069 for a trace width of exactly 5 divisions

Sensitivity final Y-amplifier:

- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Press AUTO SET key.
- Set UP-DOWN ch.A to 20 mV.
- Press AC/DC key ch.A for DC input coupling.
- Adjust R3038 for a vertical display of exactly 5 divisions.

Gain adjustment channel B:

- Apply a 100 mV/1 kHz calibrated square-wave signal to input B.
- Press AUTO SET key.
- Set UP-DOWN ch.B to 20 mV.
- Press AC/DC key ch.B for DC input coupling.
- Adjust R1169 for a vertical display of exactly 5 divisions.

- Apply a 10 mV/1 kHz calibrated square-wave signal to input B.
- Press AUTO SET key.
- Set UP-DOWN ch.B to 2 mV.
- Press AC/DC key ch.B for DC input coupling.
- Adjust R1176 for a vertical display of exactly 5 divisions.

Gain x10 adjustment channel A:

- Apply a 10 mV/1 kHz calibrated square-wave signal to input A.
- Press AUTO SET key.
- Set UP-DOWN ch.A to 2 mV.
- Press AC/DC key ch.A for DC input coupling.
- Adjust R1076 for a vertical display of exactly 5 divisions.

13.4.7 Offset adjustments

The adjustment in this Section are performed in SERVICE MENU "1".
To enter this service menu, proceed as follows:

- Press MENU key.
- Keep MENU key pressed and press also AUTO SET key.
- Check LCD displays: "1", "2" and "3".
- Press V-ch.A (c.i. the left side of the channel A UP-DOWN control).
- Check LCD displays: "1.0".
- Each adjustment procedure can now be sequentially selected by pressing the MENU key. The LCD will indicate which order is selected (1.0...1.8).
- Adjust the potentiometers for minimum trace jump.

MEASURING	ADJUSTMENT	POTENTIOMETER	REMARKS
1.0	1-2-5 adjustment	R1036 (R1136)	
1.1	x1 continue	R1064 (R1164)	rotate VAR A (B)
1.2	x1/x10 offset	R1072 (R1172)	
1.3	trig. balance A	R1091	
1.4	trig. balance B	R1191	
1.5	trig. balance EXT	R1217	
1.6	NORM/INV.	R2212	

- Press AUTO SET key twice to leave the service menu again.

Y balance:

- Press A/B key so that both channels are displayed.
- Press ADD/INVERT key for added display.
- Adjust Y POS A and Y POS B control so that the tree traces covers each other.
- Adjust R3007 so that the trace is in the centre of the screen.

Horizontal balance:

- Press MENU key.
- Press AUTO SET key.
- Set starting point of the trace to the first vertical graticule line.
- Press X DEFL key.
- Adjust R2330 so that the point is in the centre of the screen.

13.4.8 Adjustment of trigger sensitivity

- Apply a 80 mV/10 kHz sine-wave signal to input A
- Press AUTO SET key.
- Set UP-DOWN ch.A to 0,2 V.
- Set UP-DOWN TB to 0,1 msec.
- Ensure that the trace height is exactly 0,4 division.
- Adjust R4009 for a well triggered display.

13.4.9 Adjustment of the TB sweep times

Adjustment of 1 msec:

- Apply a 1 msec time marker signal to input A.
- Press AUTO SET key
- Set UP-DOWN TB to 1 msec.
- Adjust R4108 and the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines.

Adjustment of 1 microsec:

- Change the time marker signal to 1 microsec.
- Set UP-DOWN TB to 1 microsec.
- Adjust R4107 and manipulate the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines.

13.4.10 Adjustment of x10 sweep times

Adjustment of 100 microsec:

- Apply a 100 microsec. time marker signal to input A.
- Press AUTO SET key.
- Set UP-DOWN TB to 1 msec.
- Press TB MAGN key for x10 magnification.
- Ensure that the LCD gives a 0,1 ms display.
- Adjust R4721 and the X POS control so that the 2nd and 10th marker pulses coincide exactly with the 2nd and 10th vertical graticule lines. This must be valid over 10 % to 90 % of the total X-deflection range.

13.4.11 Square-wave response of final Y-amplifier

Adjustment of square-wave response:

- Apply a 120 mV/1 MHz calibrated square-wave signal with rise time faster than 1 nsec to input A.
- Press AUTO SET key.
- Set UP-DOWN ch.A to 20 mV.
- Set UP-DOWN TB to 0,5 microsec.
- Adjust the square-wave response with R3017.
- Set UP/DOWN TB to 0,1 microsec.
- Adjust the square-wave response with R3013 and C3007.
- Press TB MAGN key for x10 magnification.
- Adjust the square-wave response with C3004, C3005, C3016 and R3036.
- Remove the input signal again.

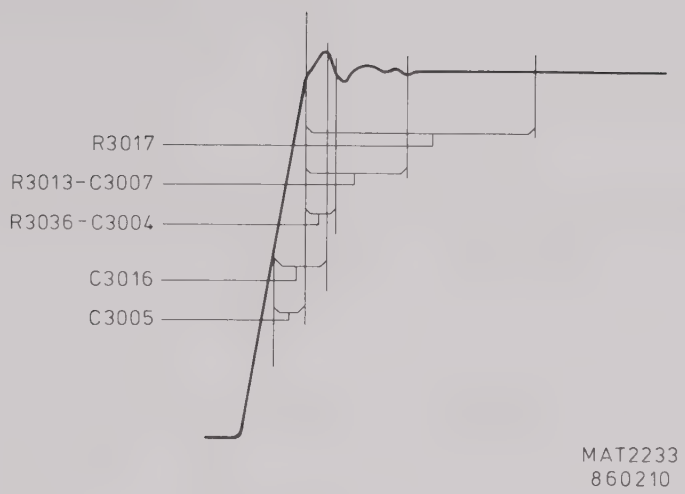


Figure 13.2 Square-wave response

Checking the chopper interference:

- Press A/B key so that both channels A and B are displayed.
- Press ALT/CHOP key for a chopped display.
- Set UP-DOWN ch.A and ch.B to 1 V.
- Press TB MAGN again for x1 magnification.
- Set UP-DOWN MTB to 0,5 msec.
- Press both 0 keys for channel A and B.
- Adjust Y POS A and Y POS B controls for a 6 division distance between both lines.
- Ensure that the chopper interference between both channels is as small as possible; if necessary, readjust R3017.

NOTE: When readjustment of R3017 is necessary, it is recommended to ensure that the h.f. square-wave response is still correct. If necessary, readjust the relevant adjusting components.

Bandwidth check:

The indications for channel B are shown in brackets after those of channel A.

- Apply a 120 mV/50 kHz calibrated sine wave signal to input A(B). This 6 division signal amplitude functions as a reference.
- Press AUTO SET key.
- Set UP-DOWN ch.A (ch.B) to 20 mV.
- Set UP-DOWN MTB to 0,1 msec.
- Ensure that the amplitude display on the screen does not become smaller than 4,2 divisions over the total frequency range up to 50 MHz.

13.4.12 Checking the AUTO SET function

- Set UP-DOWN ch.A to 10 V.
- Set UP-DOWN MTB to 0,5 sec.
- Apply a 120 mV/1 kHz sine-wave to input A.
- Press AUTO SET key.
- Ensure that a triggered sine-wave signal is visible on the screen with 2...5 division amplitude and 2...5 periods.

14. CORRECTIVE MAINTENANCE

14.1 REPLACEMENTS

WARNING: The EHT cable is directly connected to the CRT.
When the EHT cable to the post-acceleration anode is disconnected, the cable must be discharged by shorting the terminal to the instrument's earth.

14.1.1 Standard parts

Electrical and mechanical replacement parts can be obtained through your local Philips organisation or representative. However, many of the standard electronic components can be obtained from other local suppliers. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating and description.

NOTE: Physical size and shape of a componenent may affect the instrument's performance, particularly at high frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade the instrument's performance.

14.1.2 Special parts

In addition to the standard electronic components, some special components are used:

- Components, manufactured or selected by Philips to meet specific performance requirements.
- Components which are important for the safety of the instrument.

ATTENTION: Both type of components may only be replaced by components obtained through your local Philips organisation of representative.

14.1.3 Transistors and Integrated Circuits

- Return transistors and IC's to their original positions, if removed during routine maintenance.
- Do not renew or switch semi-conductor devices unnecessarily, as it may affect the calibration of the instrument.
- Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket or pcb-holes and cut the leads to the same length as on the component being renewed.
- When a device has been renewed, check the operation of the part of the instrument that may be affected.
- When re-installing power-supply transistors, use silicon grease to increase the heat-transfer capabilities.

WARNING: Handle silicon grease with care. Avoid contact with the eyes. Wash hands thoroughly after use.

14.1.4 Static-sensitive components

This instrument contains electrical components that are susceptible to damage from static discharge. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

14.1.5 Handling MOS devices

Though all our MOS integrated circuits incorporate protection against electrostatic discharges, they can nevertheless be damaged by accidental over-voltages. In storing and handling them, the following precautions are recommended.

CAUTION: Testing or handling and mounting calls for special attention regarding personal safety. Personnel handling MOS devices should normally be connected to ground via a resistor.

14.1.5.1 Storage and transport

Store and transport the circuits in their original packing. Alternatively, use may be made of a conductive material or a special IC carrier that either short-circuits all leads or insulates them from external contact.

14.1.5.2 Testing or handling

Work on a conductive surface (e.g. metal table top) when testing the circuits or transfering them from one carrier to another. Electrically connect the person doing the testing or handling to the conductive surface, for example by a metal bracelet and a conductive cord to a chain. Connect all testing and handling equipment to the same surface. Signals should not be applied to the same surface. Signals should not be applied to the inputs while the device power supply is off. All unused input leads should be connected either to the supply voltage or to ground.

14.1.5.3 Mounting

Mount MOS integrated circuits on printed circuit boards after all other components have been mounted. Take care that the circuits themselves, metal parts of the board, mounting tools, and the person doing the mounting are kept at the same electrical (ground) potential.
If it is impossible to ground the printed-circuit board, the person mounting the circuits should touch the board before bringing the MOS circuits into contact with it.

14.1.5.4 Soldering

Soldering iron tips, including those of low voltage irons, or soldering baths should also be kept at the same potential as the MOS circuits and the board.

14.1.5.5 Static charges

Dress personnel in clothing of non-electrostatic material (no wool, silk or synthetic fibres). After the MOS circuits have been mounted, the proper handling precautions should still observed. Until the sub-assemblies are inserted into the complete system in which the proper voltages are supplied, the board is not more than an extension of the leads of the devices mounted on the board. To prevent static charges from being transmitted through the board wiring to the device it is recommended that conductive clips or conductive tape is put on the circuit board terminals

14.1.5.6 Transient voltages

To prevent permanent damage due to transfer voltages, do not insert or remove MOS devices, or printed-circuit boards with MOS devices, from test sockets or systems with power on.

14.1.5.7 Voltage surges

Beware of voltage surges due to switching electrical equipment ON or OFF, relays and d.c. lines.

14.2 REMOVING THE UNITS AND MECHANICAL PARTS

NOTE: For installation, reverse the sequence.

14.2.1 Attenuator unit (A1)

- Push gently both clamping lips that secure the metal locking plate for the attenuator unit and remove the locking plate.
- Push the attenuator unit backwards for about 1 cm.
- Remove the front unit (see section 14.2.7).
- Remove the control knobs of the CRT control unit.
- Pull gently both clamping lips that secure the front profile gently backwards and loosen the front profile.

ATTENTION: To avoid damage, ensure that the BNCs of the attenuator unit are behind the front profile before loosening the front profile.

Now the attenuator unit can easily pulled out of the instrument after removing the connector with flat cable and the ground connector.

Dismantling the Attenuator unit:

- For access to the components of the unit, remove both upper and bottom covers.
- When removing the BNCs first unsolder the wire to the p.c.b. and then unscrew the BNC-nut with a spanner of max. 5 mm thickness.

14.2.2 Pre-amplifier unit (A2)

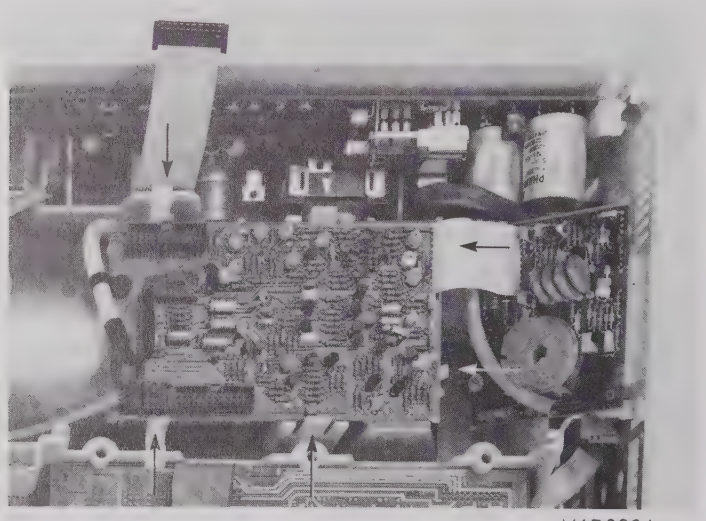
- First remove the time-base unit (see section 14.2.4).
- Unlock the two p.c.b. supports
- The complete p.c.b. can be removed from the instrument after having removed all flat cables.

14.2.3 XYZ-amplifier unit (A3)

The XYZ amplifier unit incorporates two separate p.c.b.'s connected via a flat cable. One p.c.b. includes among other things the CRT socket and must be loosened first. For this, the CRT socket must be gently removed from the CRT.

Now the part situated above the CRT can be removed as follows:

- Remove all flat cables and the delay line cable plug.
- Pull all six clamping lips that secure the XYZ-amplifier unit p.c.b. outwards and take out the complete unit.



MAT 2234

Figure 14.1 Six clamping lips for XYZ-amplifier unit

14.2.4 Time-base unit (A4)

- Unlock the p.c.b. support with a special tool that fits the diameter of the p.c.b. support (see section 14.6.2).
- The complete p.c.b. can be taken out of the instrument after having removed all flat cables.

14.2.5 CRT control unit (A5)

- Remove the front unit (see section 14.2.7)
- Loosen the front profile (see section 14.2.1)
- Now the CRT control unit can be pulled out of the front profile after having removed the flat-cable and the CAL connector.

14.2.6 Power supply unit (A6)

WARNING: Inside the power supply p.c.b. there are many parts that carry dangerous high voltages. Some of these voltages remain some time after disconnecting the instrument from the mains. Therefore, it is recommended to wait at least five minutes after having disconnected the instrument from the mains, before removing the p.c.b. If working on the power supply unit under live condition cannot be avoided, it must be done by a qualified technician who is aware of the dangers involved.

- Remove the extension shaft from the ON/OFF switch by pushing both sides of the end of the shaft together.
- Push both clamping lips that secure the power supply unit.
- Lift the power supply unit outside the instrument.
- Place the p.c.b. in the unit slider.

NOTE: After the above actions, the power supply unit can be measured under working conditions, provided that all cables are still connected to the unit.

NOTE: The flat cable to the CRT control unit can easilly be removed now when removing this unit.

- Remove the two flat cables, the power supply cable, the two- and three-pole cable connectors and the EHT-connector from the CRT.

WARNING: The EHT cable is directly connected to the CRT. When the EHT cable to the post-acceleration anode is disconnected, the cable must be discharged by shorting the terminal to the instrument's earth.

- The power supply can now be taken out of the instrument.

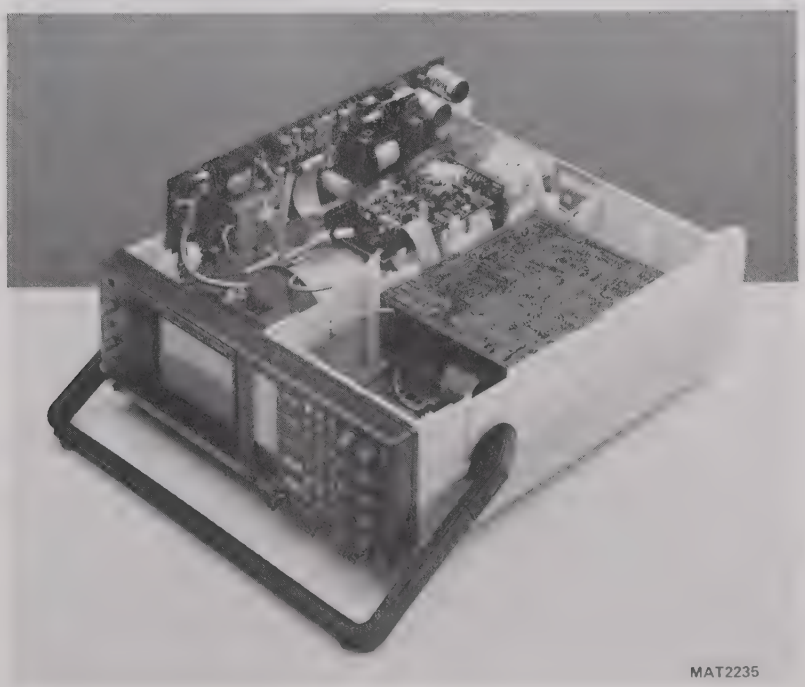


Figure 14.2 Power supply unit outside the instrument

14.2.7 Front unit (A7) and LCD unit (A8)

- Unscrew the two screws, located at the rear of the front unit.
- Now the complete unit assembly can be slid out of the front profile of the instrument.

NOTE: After the above actions, the front unit can be measured under working conditions, provided that the flat cable is still connected to the unit.

Figure 14.3 Measuring the front unit working condition

For accessibility to the component side of the front unit and LCD unit, proceed as follows:

- Unplug the connector with flat cable
- Remove all control knobs; the knobs can easily pulled off the potentiometer spindles
- Pull all clamping lips that secure the front unit p.c.b. gently outwards and loosen the text plate.

NOTE: The LCD unit is connected to the front unit by means of two 3-pin connectors and can be easily pulled off.
The LCD display lamp can be reached after pulling off the LCD unit.

ATTENTION: The LCD is unbreakely connected to the LCD and cannot exchanged as a separate component.
When the LCD is defective, the complete LCD unit must be replaced.

14.2.8 Removing the delay line cable

The delay line cable is a 54 cm cable that is connected to the amplifier unit and to the XYZ amplifier unit.
To remove the delay line cable, proceed as follows:

- For access to the delay line cable, remove the time-base unit (see section 14.2.4) and the pre-amplifier unit (see section 14.2.2).
- Unlock the plastic clamps that fix the cable to the instrument's chassis and to the units.
- Remove the plug that connect the delay line cable to the pre-amplifier unit.
- Unscrew the plastic clamp that fix the cable to the XYZ-amplifier unit.
- Remove the plug that connects the delay line cable to the XYZ-amplifier unit.

14.2.9 Replacement of CRT

IMPORTANT: It is strongly recommended to study of this chapter and the associated illustration (figure 14.4) before starting replacement.

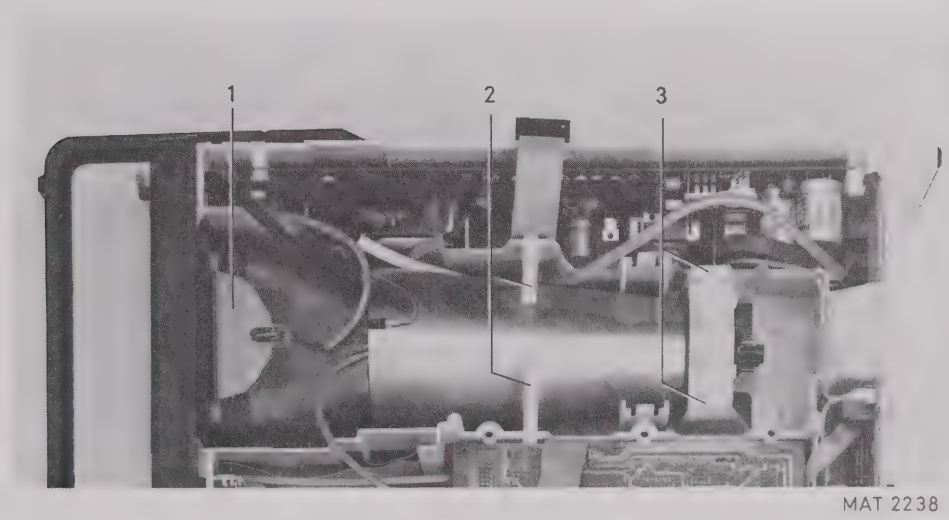


Figure 14.4 Removing the CRT

- Remove the XYZ-amplifier unit, see section 14.2.3.
- Remove the graticule lamp holder (1).
- Remove the bezel with the screen filter.
- Remove the two plastic pcb supports (2).
- Unlock the EHT-cable.

WARNING: Handle the CRT carefully. Rough handling or scratching can cause the CRT to implode.

- Push the two clamping lips that secure the CRT support (3) and gently lift the CRT, incl. metal shielding out of the instrument.

NOTE: Before re-assembling a new CRT, first remove its protective cover and place the CRT front rubber around the CRT-front.

14.3 SOLDERING TECHNIQUES

Working method:

- Carefully unsolder one after the other the soldering leads of the semi-conductor.
- Remove all superfluous soldering material. Use a suction iron of suction litze wire.
- Check that the leads of the replacement part are clean and pre-tinned on the soldering place.
- Locate the replacement semi-conductor exactly on its place, and solder each lead to the relevant printed conductor on the circuit board.

NOTE: Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the leads must not exceed 250°C. The use of solder with a low melting point is therefore recommended.
Take care not to damage the plastic encapsulation of the semi-conductor (softening point of the plastic is 150°C).

ATTENTION: When you are soldering inside the instrument, it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

Suitable soldering irons are:

- ORYX micro-miniature soldering instrument, type 6 A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, type 800/12 W-6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1mm pin-point tip, order no. 4822 395 10012.

Ordinary 60/40 solder with core and 35 to 40 W pencil type soldering iron can be used for the majority of the soldering. If a higher wattage-rating soldering iron is used on the etched circuit boards, excessive heat can cause the etched circuit wiring to separate from the board base material.

14.4 INSTRUMENT REPACKING

If the instrument is to be shipped to a Service Centre for service or repair, attach a tag showing the full address and the name of the individual at the users firm that can be contacted. The Service Centre needs the complete instrument, its serial number and a fault description. If the original packing is not available, repack the instrument in such a way that no damage occurs during transport.

14.5 TROUBLE SHOOTING

14.5.1 Introduction

The following information is provided to facilitate trouble shooting. Information contained in other sections of the manual should also be used to locate the defect. An understanding of the circuit is helpful in locating troubles, particularly where integrated circuits are used. Refer to the circuit description for this information.

14.5.2 Trouble-shooting techniques

If a fault appears, the following test sequence can be used to find the defective part:

- Check if the settings of the controls of the oscilloscope are correct. Consult the Operating Instructions.
- Check the equipment to which the oscilloscope is connected and the interconnection cables.
- Check if the oscilloscope is well-calibrated. If not, refer to section 13. "Checking and Adjusting".
- Visually check the part of the oscilloscope in which the fault is suspected. In this way, it is possible to find faults such as bad soldering connections, bad interconnection plugs and wires, damaged components or transistors and IC's that are not correctly plugged into their sockets.
- Location of the circuit part in which the fault is suspected: the symptom often indicates this part of the circuit. If the power supply is defective the symptom will appear in several circuit parts.

After having carried out the previous steps, individual components in the suspected circuit parts must be examined:

- Transistors and diodes.

  Check the voltage between base and emitter (0,7 V approx. in conductive state) and the voltage between collector and emitter (0,2 V approx. in saturation) with a voltmeter or an oscilloscope. When removed from the p.c.b. it is possible to test the transistor with an ohmmeter since the base/collector junctions can be regarded as diodes. Like a normal diode, the resistance is very high in one direction and low in the other direction. When measuring take care that the current from the ohmmeter does not damage the component under test. Replace the suspected component by a new one if you are sure that the circuit is not in such condition that the new component will be damaged.

- Integrated circuits.

  In circuit, testing can be done with an oscilloscope or voltmeter. A good knowledge of the circuit part undertest is essential. Therefore, first read the circuit descriptions in sections 3...10.

- Capacitors.

  Leakage can be traced with an ohmmeter adjusted to its highest resistance range. When testing take care of polarity and maximum allowed voltage. An open capacitor can be checked if the response for AC signals is observed. Also a capacitance meter can used: compare the measured value with the value and tolerance indicated in the parts list.

- Resistors.

  Can be checked with an ohmmeter after having unsoldered one side of the resistor from the p.c.b. Compare the measured value with the value and tolerance indicated in the parts list.

- Coils and transformers.

  An ohmmeter can be used for tracing an open circuit. Shorted or partially shorted windings can be found by checking the waveform responses when HF signals are passed through the circuit. Also an inductance meter can be used.

- Data latches.

  To measure on inputs and outputs of data latches ameasuring oscilloscope can be triggered by the clock signal which is connected to the clock input of the data latch.
  This measurement can only be made in this way when there is an acceptable repetition time of the clock signal. A too low clock pulse repetition time results in a low intensity of the trace on the measuring oscilloscope screen.
  The outputs can easily be checked by a voltmeter or oscilloscope.

14.5.3 Power-up routine

Every time the instrument is switched-on the following initialisation program is executed:

- Resetting the IIC-bus.
- Resetting D2603 (OQ 0200)
- Determinig the SLAVE-address of D2603.
- Checking if Service routine is required (if yes the program will continue with the service routine).
- Checking the "WATCH-DOG" on A7 (if HIGH, all relevant LCD-segments will be lighting for about 1 sec).
- Eventually initialisation of the IEEE-option.

If during the program-run a circuit is found to be faulty, the program stops. It is recommended to switch-off and after a few seconds switch-on again. This will reset the micro-computer controlled system automatically. If the instrument goes in the same faulty situation again, the following procedure indicates how to handle. If no faulure is found, all relevant LCD-segments will be lighting for about one second. After this the normal program is executed.

PROCEDURE:

Check the SDA and SCL lines after haved switched-on. On the SCL a clock-pulse must be present, while the SDA gives the data-information (looks like a random pulse). If one of these signals is not present, you can localize on what unit the fault exists. This can be done by first unplug connector X1009 or X2001 on resp. A1 and A2. To localize what serial-parallel conversion IC is defective, you can disconnect the solder joint in the SDA and SCL print track lead to that IC.
The following IC's can disconnected in this way: D1001, D1101, D2602, D2603, D4001, D4002, D4401.

When the instrument restarts every time again, this means the WATCHDOG is initiating the main program (see also Section 10.1.4), the watchdog can be disabled. This can be done by means of the solder joint jumper on the rear of the front unit pcb (near X7001).
When disabled, pin 13 of the microcomputer is set to a low level.

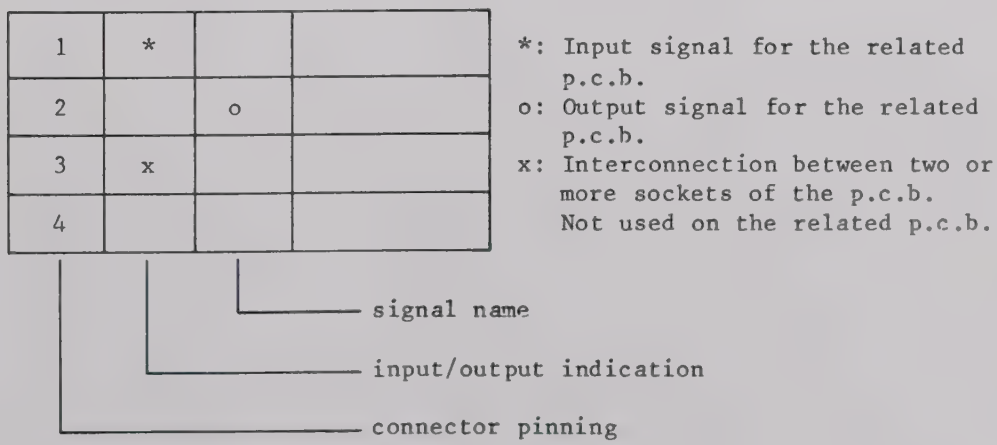
14.5.4 Trouble-shooting the power supply

To determine whether a certain fault condition is initiated by the power supply itself or by the connected oscilloscope circuits, a dummy load is listed in the table below. The table gives also an example of the resistor types that can be used to compose the dummy load. These resistors can be ordered at Concern Service.

Supply voltage	Output current	Dummy resistance and their service ordering numbers
+ 5 V	2,4 A	2,1E-12W: 3 x 8,2E (4822 112 21052) and 10E (4822 112 21054) in parallel.
- 6,4 V	930 mA	6,9E-65W: 8,2E (4822 12 41052) and 47E (4822 110 23072) in parallel.
+ 12 V	720 mA	17,2E-8,7W: 33E (4822 112 41067) and 39E (4822 112 43069) in parallel.
- 12 V	500 mA	24,7E-6W: 39E (4822 112 41069) and 68E (4822 112 41076) in parallel.
+ 17 V	340 mA	51E-6W: 1E (4822 112 23027)in serial with 2 x 100E(4822 112 41081) in parallel.
- 17 V	100 mA	171E-1,7W: 270E (4822 110 43098) and 470E (4822 110 43098) in parallel.
+ 48 V	140 mA	341E-7W: 330E (4822 112 41094) in serial with 12E (4822 110 23056).
- 48 V	40 mA	1k22-2W: 2k2 (4822 110 23169) and 2k7 (4822 110 23172) in parallel.

14.5.5 P.c.b. interconnections

Figure 14.5 gives a survey of all interconnections between the p.b.c.'s and to the CRT. Also the interconnections between the connectors on board level is given in this diagram.
An explanation of the connector indication is given below:



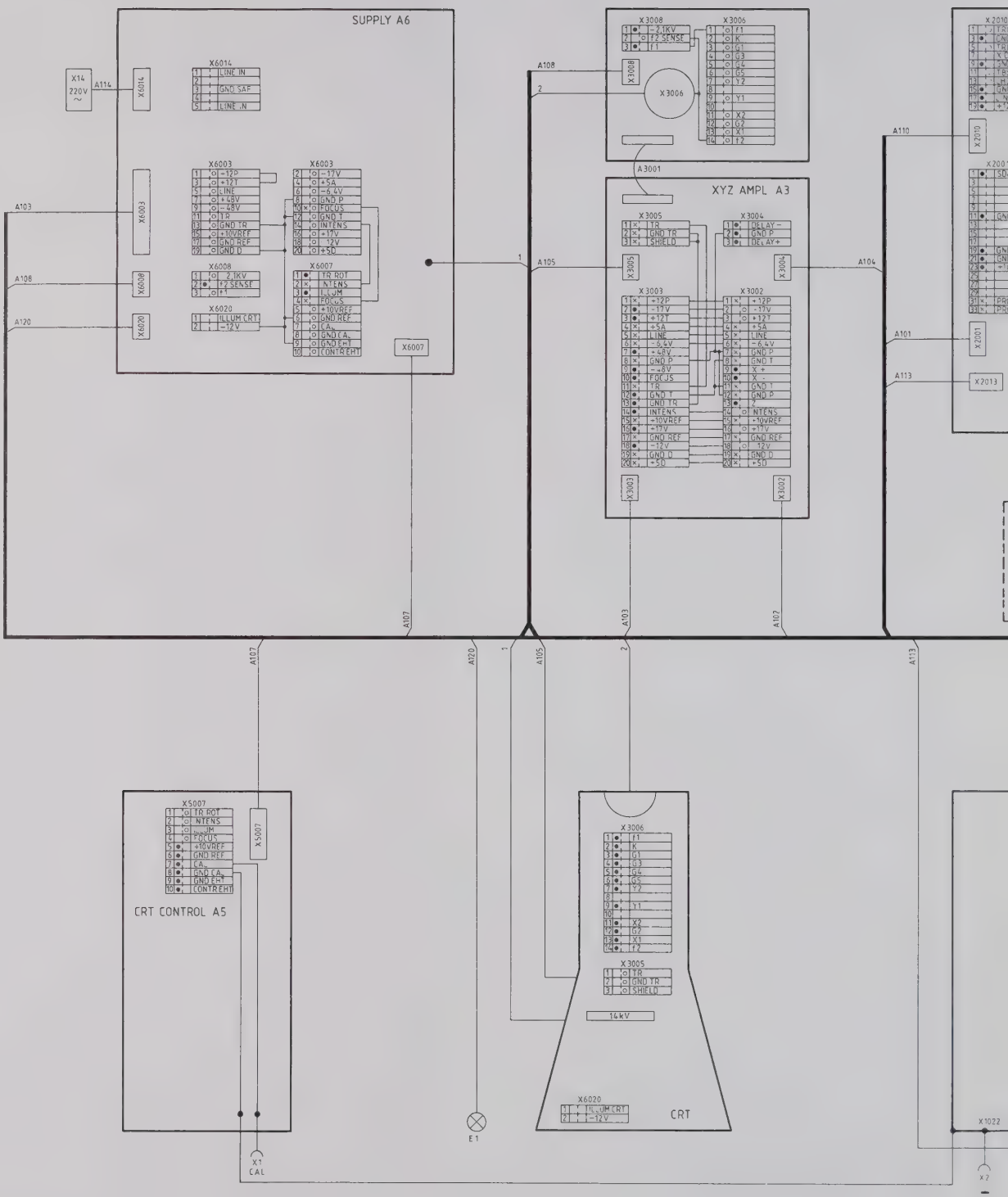
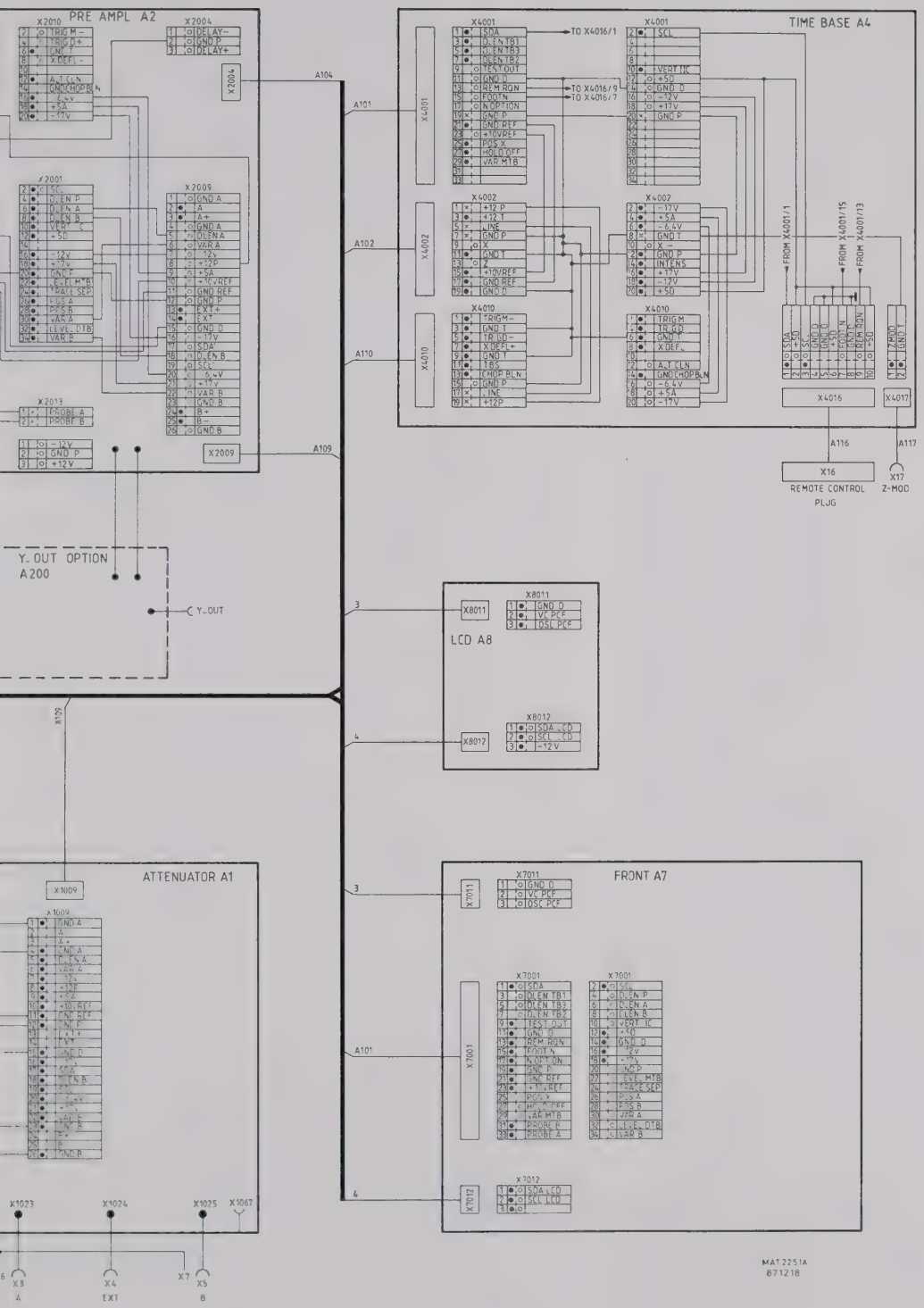


Figure 14.5 P.c.b. interconnections


PRE AMPL A2
TIME BASE A4
TO X4016/1
TO X4016/9
TO X4016/7
FROM X4001/1
FROM X4001/15
FROM X4001/13
X4016
X4017
A116
A117
X16
REMOTE CONTROL PLUG
X17
Z-MOD
Y-OUT OPTION A200
Y-OUT
LCD A8
ATTENUATOR A1
FRONT A7
A104
A101
A102
A110
A109
A105
MAT 2251A 871218

14.5.6 Signal waveforms

The signal waveforms in the circuit diagrams can be measured on the measure points (X...).

CONDITION: - Apply the CAL voltage via a 1:10 probe to input ch. A
- Press AUTO SET

If addition operation is needed, it is stated.

14.5.7 Semi conductor pinnings

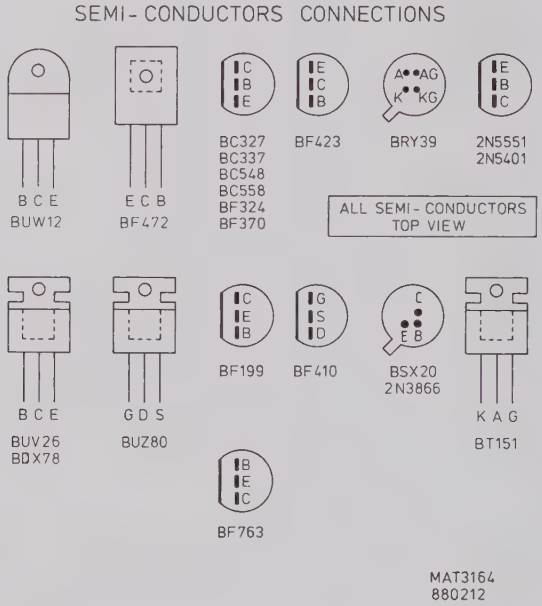


Figure 14.6

14.6 SPECIAL TOOLS

14.6.1 Trimming Kit SBC 317 - 4822 310 50095

The SBC 317 Trimming Kit matches every current trimming requirement for all products. The set contains 27 items (22 different bits, plus 3 bit holders and 2 extension pieces). The insulated holders and extension pieces make it easy to reach into a chassis and make accurate adjustments, without wasting time or risking shocks. The SBC 317 Trimming Kit is packed in a flat transparent case. Several of the most commonly required bits are duplicated. In addition, a spare set of 8 bits is separately available as replacement (4822 310 50016).

The Trimming Kit contains the following parts:

Figure 14.7 Trimming tool kit

14.6.2 P.c.b. snapper - 5322 535 91942

A special tool is available for removal of the pcb from the p.c.b. supports. Information on how to use this tool is given in chapter 14.2. The ordering number of this tool is 5322 535 91942

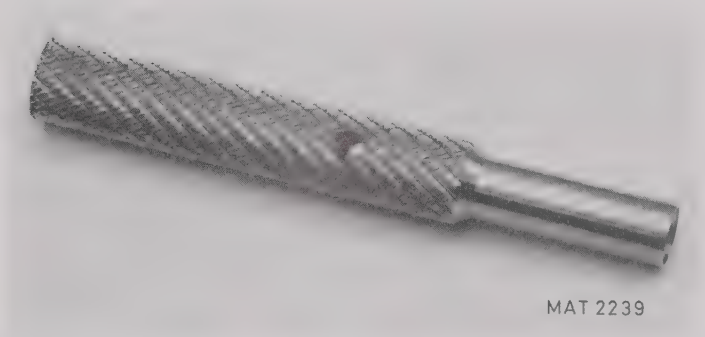


Figure 14.8 P.c.b. snapper

14.7 RECALIBRATION AFTER REPAIR

After any electrical component has been renewed the calibration of its associated circuit should be checked, as well as the calibration of other closely-related circuits.
Since the power supply affects all circuits, calibration of the entire instrument should be checked it work has been done in the power supply or if the transformer has been renewed.

15. SAFETY INSPECTION AND TEST AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

15.1 GENERAL DIRECTIVES

- Take care that the creepage distances and clearances have not been reduced.
- Before soldering, the wires should be bent through the holes of solder tags, or wrapped around the tag in the form of an open U, or, wiring ridigity shall be maintained by cable clamps or cable lacing.
- Replace all insulating guards and -plates.

15.2 SAFETY COMPONENTS

Components in the primary circuit may only be renewed by components selected by Philips, see also section 14.1.2.

15.3 CHECKING THE PROTECTIVE EARTH CONNECTION

The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0,1 Ohm. During measurement the mains cable should be removed from the mains. Resistance variations indicate a defect.

15.4 CHECKING THE INSULATION RESISTANCE

Measure the insulation resistance at U = 500 V dc between the mains connections and the protective lead connections. For this purpose, set the mains switch to ON. The insulation resistance shall not be less than 2 Meg-ohm.

NOTE: 2 Meg-ohm is a minimum requirement at 40°C and 95 % Relative Humidity. Under normal conditions the insulation resistance should be much higher (10 ... 20 Meg-ohm).

15.5 CHECKING THE LEAKAGE CURRENT

The leakage current shall be measured between each pole of the mains supply in turn, and all accessible conductive parts connected together (including the measuring earth terminal).
The leakage current is not excessive if the measured currents from the mentioned parts does not exceed 0,5 mA rms.

15.6 VOLTAGE TEST

The instrument shall withstand, without electrical breakdown, the application of a test voltage between the supply circuit and accessible conductive parts that are likely to become energized.
The test potential shall be 1500 V rms at supply-circuit frequency, applied for one second.
The test shall be conducted when the instrument is fully assembled, and with the primary switch in the ON position.
During the test, both sides of the primary circuit of the instrument are connected together and to one terminal of the voltage test equipment; the other voltage test equipment terminal is connected to the accessible conductive parts.

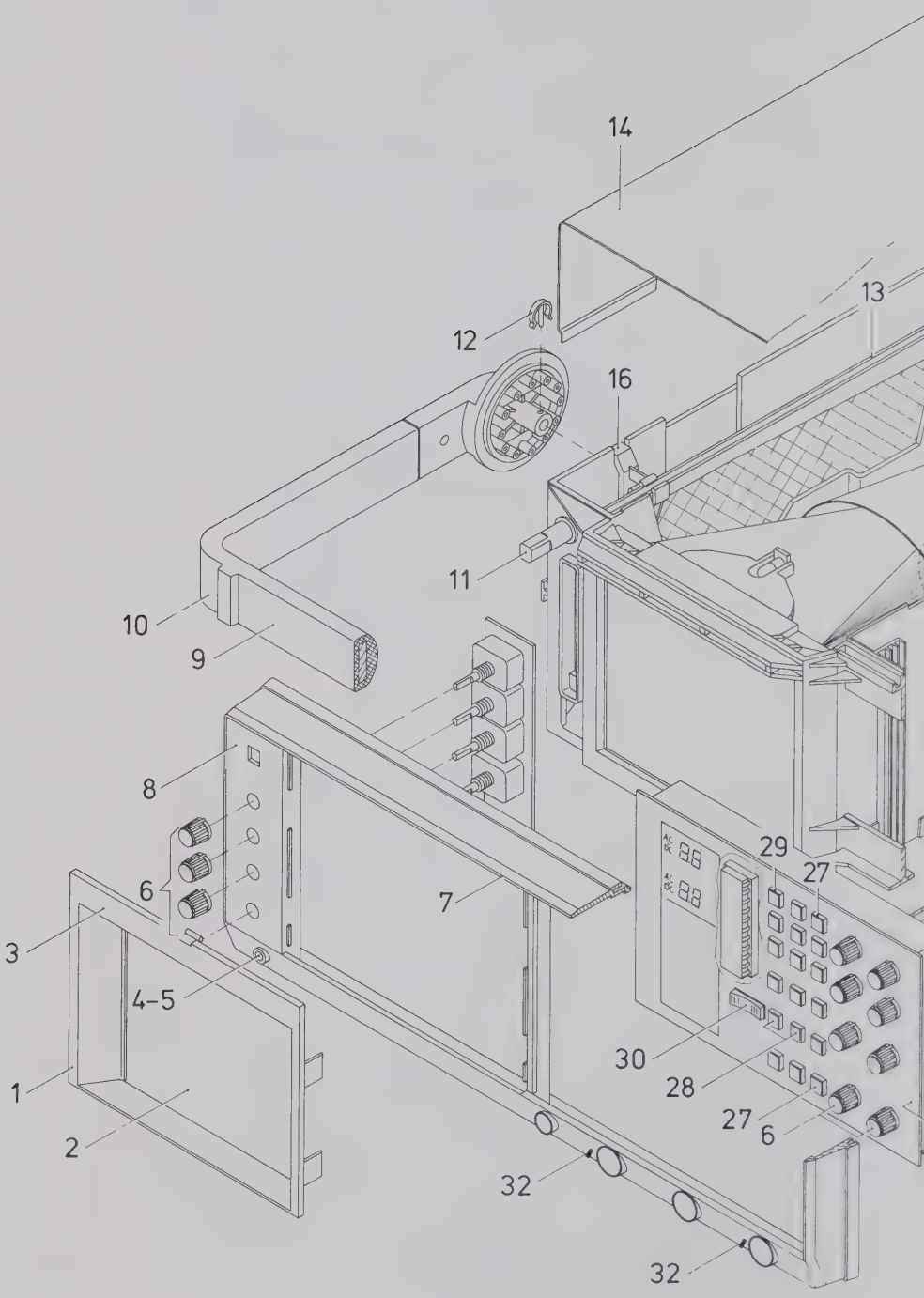
16. PARTS LIST

(subject to alteration without notice)

16.1 MECHANICAL PARTS

16.1.1 Mechanical parts indicated in figure 16.1.

Item	Qty	Ordering code	Description
1	1	5322 381 10779	Bezel
2	1	5322 480 30181	Contrast filter blue
3	1	5322 455 81073	Textfilm on bezel PM3050
	1	5211 455 81074	Textfilm on bezel PM3052
4	1	5322 268 14052	CAL socket
5	1	4822 530 70296	Clamping spring for CAL socket
6	11	5322 414 10018	Control knob with spring
7	1	5322 464 90252	Front frame
8	1	5322 455 81026	Textfilm CRT unit
9	1	5322 455 81031	Textfilm for handle
10	1	5322 498 50219	Handle assembly
11	1	5322 414 60142	Power-on knob, green-brown
12	2	5322 492 63355	Spring for handle
13	1	5322 535 80735	Extension part for power-on switch
14	1	5322 464 90248	Upper cabinet
15	2	5322 462 10265	P.c.b. support for A3
16	2	5322 462 10264	P.c.b. guiding for A6
17	1	5322 464 90486	Chassis
18	6	5322 462 30304	P.c.b. support
19	1	5322 464 90249	Bottom cabinet
20	2	5322 464 90253	Attenuator cover
21	4	5322 462 50325	Bottom foot
22	3	5322 506 41006	BNC nut
23	3	5322 532 21188	BNC spacer ring
24	3	5322 267 10004	BNC socket
25	1	5322 464 90254	Front unit frame
26	1	5322 455 81027	Textfilm for front unit
27	18	5322 276 11856	Softkey brown
28			
29	1	5322 276 11857	Softkey green
30	3	5322 277 10878	UP-DOWN key brown
31			
32	2	5322 492 63354	Range indication spring
--	1	5322 450 60952	LCD window
--	3	5322 401 10954	Delay line cable clamp
--	2	5322 255 40054	Heatsink for V3011 and V3012


14
13
12
16
11
10
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8
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7
29
27
3
4–5
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28
27
6
32
32

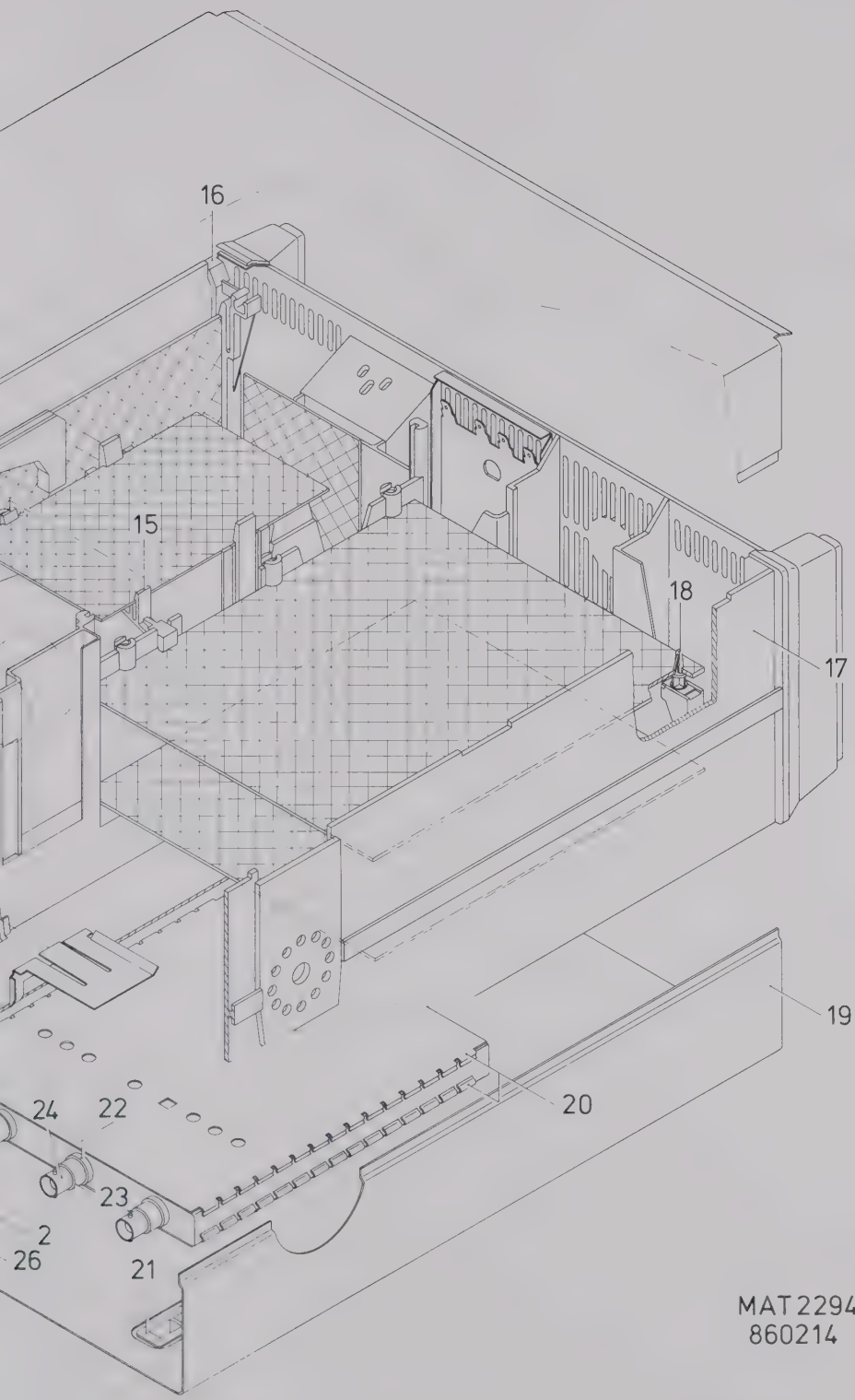


Figure 16.1 Exploded view

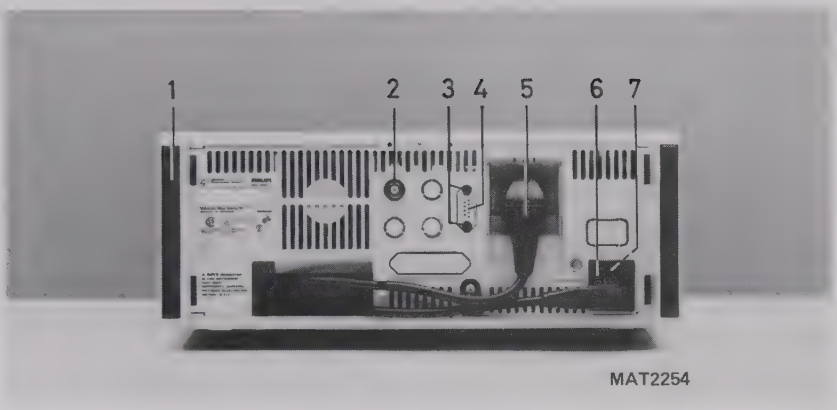


Figure 16.2 Rear view

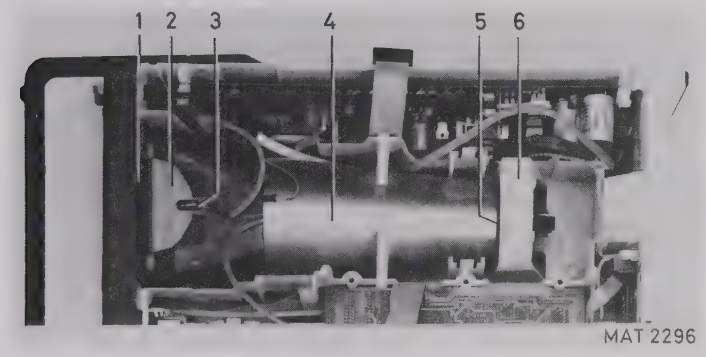


Figure 16.3 Inside view showing the parts in the CRT compartiment

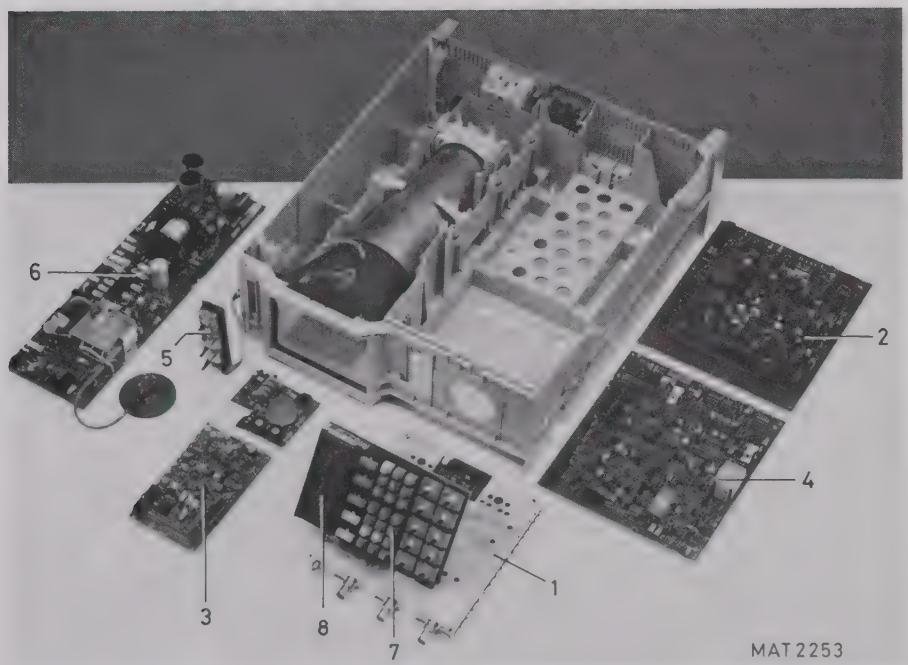


Figure 16.4 View of the units

16.1.2 Mechanical parts indicated in figure 16.2

Item	Qty	Ordering code	Description
1	2	5322 462 50324	Rear foot
2	1	5322 267 10004	BNC socket for Z-MOD
3	2	5322 502 12003	Screw for Remote control socket and Mains socket
4	1	5322 321 22665	Remote control socket, incl. cable
5	1	5322 321 21616	Line cable, European version
	1	5322 321 10446	Line cable, USA version
	1	5322 321 21617	Line cable, British version
	1	5322 321 21618	Line cable, Swiss version
	1	5322 321 21781	Line cable, Australean version
6	1	5322 219 81119	Mains input socket, incl. fuse holder
7	1	4822 253 30024	Fuse 1,6A (for mains input)

16.1.3 Mechanical parts indicated in figure 16.3

Item	Qty	Ordering code	Description
1	1	5322 460 60404	CRT front rubber
2	1	5322 462 40957	Light conductor for CRT
3	1	5322 134 40534	Lamp 28V-40mA
4	1	5322 466 30163	CRT shielding
5	1	5322 466 30164	CRT manchet, rubber
6	1	5322 462 10263	CRT support

16.2 UNITS (see figure 16.4)

Item	Unit nr.	Ordering code	Description
1	A1	5322 216 51114	Attenuator unit
2	A2	5322 216 51116	Pre-amplifier unit
3	A3	5322 216 51117	XYZ-amplifier unit
4	A4	5322 216 51115	Time-base unit
5	A5	5322 216 51118	CRT-control unit
6	A6	5322 216 51119	Power supply unit
7	A7	5322 216 51128	Front unit
8	A8	5322 216 51129	LCD unit

16.3 CABLES AND CONNECTORS

16.3.1 Flatcables and connectors

For the flatcables used in this oscilloscope, the required version must be made by yourself with the following parts:

- Universal flatcable, 40 wires, length 60 cm 5322 323 50112

To get the required number of wires, the flat cable must be split by means of a pair of scissors or a knife.
The cable must be cut to the required length.

- Flatcable connectors

The connectors can be mounted on the flatcable by means of a pair of pliers or in a bench-vice.

ATTENTION: check the position of the flatcable in the connector before pressing the connector together.

The following connectors are available:

10 pole cable connector	X4016-X5007-X6007	5322 268 40234
20 pole cable connector	X2010-X3002-X3003-X4002-X4010-X6009	5322 268 40235
26 pole cable connector	X1009-X2009	5322 267 70175
34 pole cable connector	X2001-X4001-X7001	5322 268 40236

The following AMP-connectors are available:

2 pole-single, without contact pins	5322 268 40232
3 pole-single, without contact pins	5322 268 40233
bus contact for AMP-cable connector, per piece:	5322 268 20152
5 pole connector for power-in:	5322 267 50452
bus contact for connector, per piece:	5322 268 24128

- Flatcable connector clamp 5322 401 11156

16.3.2 P.c.b.-connectors (male headers)

Type	Item	Ordering number
2 pole-single	X2013-X4017-X6020	5322 265 20275
3 pole-single	X6006-X6019	5322 265 30434
3 pole-single	X6018 (power supply)	5322 265 40435
3 pole-single 90° type	X2004-X3004-X3005-X3008	5322 265 30433
5 pole-single	X6014	5322 265 40436
10 pole-double	X4016-X5007-X6007	5322 265 40485
20 pole-double	X2010-X3002-X3003 X4002-X4010-X6003	5322 265 51129
26 pole-double	X1009-X2009	5322 265 61071
34 pole-double	X2001-X4001	5322 265 61069
34 pole-double 90° type	X7001	5322 265 61068
CRT-socket	X3006	5322 255 40502

16.3.3 Miscelleneous cables

- Delay line cable, 54 cm long 5322 321 21595

- Flex jump cable, used for interconnection for A3 - 11 pole. 5322 290 60605

16.4 ELECTRICAL PARTS

16.4.1 CAPACITORS

POSNR	DESCRIPTION	ORDERING CODE
C 201	-20+50% 10NF	4822 122 31414
C 202	2% 100PF	4822 122 31316
C 203	7-10.0 PF	5322 125 11013
C 204	10% 1NF	4822 122 30027
C 251	-10+50% 68UF	4822 124 20689
C 252	-20+50% 10NF	4822 122 31414
C 253	-20+50% 10NF	4822 122 31414
C 254	-10+50% 68UF	4822 124 20689
C 256	-20+50% 10NF	4822 122 31414
C 257	-20+50% 10NF	4822 122 31414
C 421	-20+50% 10NF	4822 122 31414
C 422	-20+50% 10NF	4822 122 31414
C 423	-20+50% 10NF	4822 122 31414
C 1001	-20+50% 10NF	4822 122 31414
C 1002	400V 10% 22NF	5322 121 40308
C 1003	-20+50% 10NF	4822 122 31414
C 1004	-20+50% 10NF	4822 122 31414
C 1006	-20+50% 10NF	4822 122 31414
C 1009	2% 33PF	5322 122 32072
C 1011	63V 10% 220NF	5322 121 43084
C 1012	63V 10% 220NF	5322 121 43084
C 1013	2% 15PF	4822 122 31823
C 1016	0.25PF 3.3PF	5322 122 32549
C 1017	0.25PF 3.3PF	4822 122 31821
C 1018	0.25PF 2.7PF	5322 122 32894
C 1019	2% 33PF	5322 122 32072
C 1021	-20+50% 10NF	4822 122 31414
C 1022	2% 22PF	5322 122 32143
C 1023	7-10.0 PF MUR	5322 125 11013
C 1024	-20+50% 10NF	4822 122 31414
C 1026	0.25PF 3.3PF	5322 122 32549
C 1027	0.25PF 2.2PF	5322 122 32774
C 1028	2% 33PF	5322 122 32072
C 1029	7-10.0 PF MUR	5322 125 11013
C 1031	-20+50% 10NF	4822 122 31414
C 1032	2% 33PF	5322 122 32551
C 1033	7-10.0 PF MUR	5322 125 11013
C 1034	-20+50% 10NF	4822 122 31414
C 1035	-20+50% 10NF	4822 122 31414
C 1036	2% 39PF	4822 122 31069
C 1037	2% 22PF	5322 122 32143
C 1038	2% 100PF	4822 122 31316
C 1039	0.25PF 2.2PF	4822 122 31036
C 1041	63V 10% 100NF	5322 121 43083
C 1042	-20+50% 10NF	4822 122 31414
C 1043	-20+50% 10NF	4822 122 31414
C 1044	-20+50% 10NF	4822 122 31414
C 1045	-20+50% 10NF	4822 122 31414
C 1046	-10+50% 68UF	4822 124 20689
C 1047	0.25PF 4.7PF	4822 122 31822
C 1061	10% 470PF	4822 122 30034
C 1062	0.25PF 3.3PF	4822 122 31821
C 1063	2% 33PF	5322 122 32072
C 1064	10% 680PF	4822 122 30053
C 1067	2% 68PF	4822 122 31349
C 1068	-20+50% 10NF	4822 122 31414
C 1071	-20+50% 10NF	4822 122 31414
C 1072	-20+50% 10NF	4822 122 31414
C 1076	10% 1.5NF	4822 122 31169
C 1077	10% 1.5NF	4822 122 31169
C 1101	-20+50% 10NF	4822 122 31414
C 1102	400V 10% 22NF	5322 121 40308
C 1103	-20+50% 10NF	4822 122 31414
C 1104	-20+50% 10NF	4822 122 31414
C 1106	-20+50% 10NF	4822 122 31414
C 1109	2% 33PF	5322 122 32072
C 1111	63V 10% 220NF	5322 121 43084
C 1112	63V 10% 220NF	5322 121 43084
C 1113	2% 15PF	4822 122 31823
C 1116	0.25PF 3.3PF	5322 122 32549
C 1117	0.25PF 3.3PF	4822 122 31821
C 1118	0.25PF 2.7PF	5322 122 32894
C 1119	2% 33PF	5322 122 32072
C 1121	-20+50% 10NF	4822 122 31414
C 1122	2% 22PF	5322 122 32143
C 1123	7-10.0 PF MUR	5322 125 11013
C 1124	-20+50% 10NF	4822 122 31414
C 1126	0.25PF 3.3PF	5322 122 32549
C 1127	0.25PF 2.2PF	5322 122 32774
C 1128	2% 33PF	5322 122 32072

POSNR	DESCRIPTION	ORDERING CODE
C 1129	7-10.0 PF MUR	5322 125 11013
C 1131	-20+50% 10NF	4822 122 31414
C 1132	2% 33PF	5322 122 32551
C 1133	7-10.0 PF MUR	5322 125 11013
C 1134	-20+50% 10NF	4822 122 31414
C 1135	-20+50% 10NF	4822 122 31414
C 1136	2% 39PF	4822 122 31069
C 1137	2% 22PF	5322 122 32143
C 1138	2% 100PF	4822 122 31316
C 1139	0.25PF 2.2PF	4822 122 31036
C 1141	63V 10% 100NF	5322 121 43083
C 1142	-20+50% 10NF	4822 122 31414
C 1143	-20+50% 10NF	4822 122 31414
C 1144	-20+50% 10NF	4822 122 31414
C 1145	-20+50% 10NF	4822 122 31414
C 1146	-10+50% 68UF	4822 124 20689
C 1147	0.25PF 4.7PF	4822 122 31822
C 1161	10% 470PF	4822 122 30034
C 1162	0.25PF 3.3PF	4822 122 31821
C 1163	2% 33PF	5322 122 32072
C 1164	10% 680PF	4822 122 30053
C 1167	2% 68PF	4822 122 31349
C 1168	-20+50% 10NF	4822 122 31414
C 1171	-20+50% 10NF	4822 122 31414
C 1172	-20+50% 10NF	4822 122 31414
C 1176	10% 1.5NF	4822 122 31169
C 1177	10% 1.5NF	4822 122 31169
C 1201	-20+50% 10NF	4822 122 31414
C 1202	400V 10% 22NF	5322 121 40308
C 1203	2% 33PF	5322 122 32551
C 1204	0.25PF 3.9PF	4822 122 31217
C 1206	7-10.0 PF MUR	5322 125 11013
C 1207	2% 22PF	5322 122 32143
C 1208	-20+50% 10NF	4822 122 31414
C 1210	0.25PF 0.56PF	5322 122 32107
C 1211	-20+50% 10NF	4822 122 31414
C 1212	2% 100PF	4822 122 31316
C 1216	0.25PF 4.7PF	4822 122 31822
C 1217	-20+50% 10NF	4822 122 31414
C 1401	-20+50% 10NF	4822 122 31414
C 1402	-20+50% 10NF	4822 122 31414
C 1403	-20+50% 10NF	4822 122 31414
C 1404	-10+50% 68UF	4822 124 20689
C 1405	-20+50% 10NF	4822 122 31414
C 1407	-20+50% 10NF	4822 122 31414
C 1408	-20+50% 10NF	4822 122 31414
C 1409	-10+50% 68UF	4822 124 20689
C 1411	-20+50% 10NF	4822 122 31414
C 1412	-20+50% 10NF	4822 122 31414
C 1413	-10+50% 47UF	4822 124 20699
C 1414	-20+50% 10NF	4822 122 31414
C 1420	-20+50% 10NF	4822 122 31414
C 1421	-20+50% 10NF	4822 122 31414
C 1422	-20+50% 10NF	4822 122 31414
C 1423	-20+50% 10NF	4822 122 31414
C 1424	-10+50% 68UF	4822 124 20689
C 1427	-20+50% 10NF	4822 122 31414
C 1428	-20+50% 10NF	4822 122 31414
C 1429	-10+50% 68UF	4822 124 20689
C 1431	-20+50% 10NF	4822 122 31414
C 1432	-20+50% 10NF	4822 122 31414
C 1433	-10+50% 47UF	4822 124 20699
C 1434	-20+50% 10NF	4822 122 31414
C 1441	-20+50% 10NF	4822 122 31414
C 1442	-10+50% 68UF	4822 124 20689
C 1443	-20+50% 10NF	4822 122 31414
C 1444	-20+50% 10NF	4822 122 31414
C 1446	-10+50% 68UF	4822 124 20689
C 1447	-20+50% 10NF	4822 122 31414
C 2049	10% 1.5NF	4822 122 31169
C 2050	-20+50% 10NF	4822 122 31414
C 2051	10% 1.5NF	4822 122 31169
C 2149	10% 1.5NF	4822 122 31169
C 2150	-20+50% 10NF	4822 122 31414
C 2151	10% 1.5NF	4822 122 31169
C 2201	-20+50% 10NF	4822 122 31414
C 2203	-20+50% 10NF	4822 122 31414
C 2215	0.25PF 6.8PF	4822 122 31049
C 2216	0.25PF 2.7PF	4822 122 31038
C 2217	-20+50% 10NF	4822 122 31414
C 2218	0.25PF 2.7PF	4822 122 31038
C 2220	0.25PF 5.6PF	5322 122 32163
C 2221	10% 1.5NF	4822 122 31169

POSNR	DESCRIPTION	ORDERING CODE
C 2222	0.25PF 8.2PF	4822 122 31052
C 2223	10% 1.5NF	4822 122 31169
C 2224	10% 1.5NF	4822 122 31169
C 2225	10% 470PF	4822 122 30034
C 2226	10% 470PF	4822 122 30034
C 2229	10% 470PF	4822 122 30034
C 2230	10% 470PF	4822 122 30034
C 2305	-20+50% 10NF	4822 122 31414
C 2306	10% 1.5NF	4822 122 31169
C 2307	10% 1.5NF	4822 122 31169
C 2317	0.25PF 1.5PF	5322 122 32101
C 2318	10% 470PF	4822 122 30034
C 2321	0.25PF 1.5PF	5322 122 32101
C 2326	-20+50% 10NF	4822 122 31414
C 2327	-20+50% 10NF	4822 122 31414
C 2328	63V 10% 100NF	5322 121 43083
C 2329	63V 10% 100NF	5322 121 43083
C 2331	63V 10% 100NF	5322 121 43083
C 2332	63V 10% 100NF	5322 121 43083
C 2333	63V 10% 100NF	5322 121 43083
C 2335	2% 12PF	4822 122 31056
C 2336	-20+50% 10NF	4822 122 31414
C 2337	-20+50% 10NF	4822 122 31414
C 2338	10% 470PF	4822 122 30034
C 2342	2% 22PF	5322 122 32143
C 2350	0.25PF 2.7PF	4822 122 31038
C 2600	2% 22PF	5322 122 32143
C 2601	63V 10% 100NF	5322 121 43083
C 2602	-20+50% 10NF	4822 122 31414
C 2604	10% 1.5NF	4822 122 31169
C 2611	10% 1NF	4822 122 30027
C 2612	-20+50% 10NF	4822 122 31414
C 2613	10% 470PF	4822 122 30034
C 2616	10% 470PF	4822 122 30034
C 2701	-10+50% 100UF	4822 124 20679
C 2702	-20+50% 10NF	4822 122 31414
C 2703	-20+50% 10NF	4822 122 31414
C 2704	-20+50% 10NF	4822 122 31414
C 2706	-10+50% 100UF	4822 124 20679
C 2707	-20+50% 10NF	4822 122 31414
C 2708	-20+50% 10NF	4822 122 31414
C 2709	-20+50% 10NF	4822 122 31414
C 2711	-20+50% 10NF	4822 122 31414
C 2716	-10+50% 68UF	4822 124 20689
C 2717	-20+50% 10NF	4822 122 31414
C 2718	-20+50% 10NF	4822 122 31414
C 2722	-20+50% 10NF	4822 122 31414
C 2726	-10+50% 68UF	4822 124 20689
C 2727	-20+50% 10NF	4822 122 31414
C 2728	-20+50% 10NF	4822 122 31414
C 2741	-20+50% 10NF	4822 122 31414
C 2744	-20+50% 10NF	4822 122 31414
C 2746	-20+50% 10NF	4822 122 31414
C 2747	-10+50% 68UF	4822 124 20689
C 2748	-20+50% 10NF	4822 122 31414
C 2751	-10+50% 47UF	4822 124 20699
C 2752	-20+50% 10NF	4822 122 31414
C 2753	-20+50% 10NF	4822 122 31414
C 2754	-20+50% 10NF	4822 122 31414
C 2771	-20+50% 10NF	4822 122 31414
C 2772	-10+50% 150UF	4822 124 20672
C 2773	-20+50% 10NF	4822 122 31414
C 2774	-10+50% 68UF	4822 124 20689
C 2776	-20+50% 10NF	4822 122 31414
C 2777	63V 10% 100NF	5322 121 43083
C 2781	-20+50% 10NF	4822 122 31414
C 3001	-20+50% 10NF	4822 122 31414
C 3002	10% 1.5NF	4822 122 31169
C 3003	10% 1.5NF	4822 122 31169
C 3004	7-10.0 PF MUR	5322 125 11013
C 3005	2-20PF MUR	5322 125 50296
C 3007	7-10.0 PF MUR	5322 125 11013
C 3009	2% 12PF	4822 122 31056
C 3011	2% 68PF	4822 122 31349
C 3013	0.25PF 2.7PF	4822 122 31038
C 3014	0.25PF 2.7PF	4822 122 31038
C 3016	2-20PF MUR	5322 125 50296
C 3017	-20+50% 10NF	4822 122 31414
C 3018	0.25PF 5.6PF	5322 122 32163
C 3021	-20+50% 10NF	4822 122 31414
C 3022	-20+50% 10NF	4822 122 31414
C 3101	10% 1.5NF	4822 122 31169
C 3102	10% 1.5NF	4822 122 31169
C 3104	100V 10% 47NF	5322 121 43088
C 3105	-20+50% 10NF	4822 122 31414
C 3106	63V 10% 100NF	5322 121 43083
C 3107	0.25PF 2.7PF	4822 122 31038
C 3108	0.25PF 0.82PF	4822 122 31214
C 3109	63V 10% 100NF	5322 121 43083
C 3110	-20+50% 10NF	4822 122 31414

POSNR	DESCRIPTION	ORDERING CODE
C 3111	-20+50% 10NF	4822 122 31414
C 3113	0.25PF 0.82PF	4822 122 31214
C 3114	100V 10% 47NF	5322 121 43088
C 3116	63V 10% 100NF	5322 121 43083
C 3200	0.25PF 0.56PF	5322 122 32107
C 3201	0.25PF 0.56PF	5322 122 32107
C 3202	63V 10% 100NF	5322 121 43083
C 3203	63V 10% 100NF	5322 121 43083
C 3204	-20+50% 10NF	4822 122 31414
C 3206	63V 10% 100NF	5322 121 43083
C 3208	10% 470PF	4822 122 30034
C 3209	-20+50% 2.2NF	5322 122 50093
C 3211	-20+50% 2.2NF	5322 122 50093
C 3250	100V 10% 10NF	5322 121 43086
C 3251	63V 10% 220NF	5322 121 43084
C 3252	-20+50% 2.2NF	5322 122 50093
C 3253	-20+50% 10NF	4822 122 31414
C 3254	-20+50% 10NF	4822 122 31414
C 3256	0.25PF 0.56PF	5322 122 32107
C 3257	-20+50% 10NF	4822 122 31414
C 3258	-20+50% 2.2NF	5322 122 50093
C 3301	-20+50% 10NF	4822 122 31414
C 3302	-20+50% 10NF	4822 122 31414
C 3303	-10+50% 47UF	4822 124 20699
C 3304	-20+50% 10NF	4822 122 31414
C 3306	-20+50% 10NF	4822 122 31414
C 3307	-20+50% 10NF	4822 122 31414
C 3308	-20+50% 10NF	4822 122 31414
C 3309	-20+50% 10NF	4822 122 31414
C 3311	-20+50% 10NF	4822 122 31414
C 3312	-10+50% 47UF	4822 124 20699
C 3313	-20+50% 10NF	4822 122 31414
C 3314	-10+50% 15UF	4822 124 20729
C 3316	-20+50% 10NF	4822 122 31414
C 3317	-20+50% 10NF	4822 122 31414
C 3318	-20+50% 10NF	4822 122 31414
C 3319	-10+50% 15UF	4822 124 20729
C 3321	-20+50% 10NF	4822 122 31414
C 3322	-20+50% 10NF	4822 122 31414
C 3324	-20+50% 10NF	4822 122 31414
C 3326	-20+50% 10NF	4822 122 31414
C 4001	63V 10% 100NF	5322 121 43083
C 4002	-10+50% 47UF	4822 124 20699
C 4003	63V 10% 100NF	5322 121 43083
C 4004	-20+50% 10NF	4822 122 31414
C 4005	-20+50% 10NF	4822 122 31414
C 4006	10% 4.7NF	4822 122 31125
C 4007	10% 4.7NF	4822 122 31125
C 4008	10% 470PF	4822 122 30034
C 4009	0.25PF 3.9PF	5322 122 34107
C 4011	2% 100PF	4822 122 31316
C 4021	-10+50% 47UF	4822 124 20699
C 4022	-20+50% 10NF	4822 122 31414
C 4028	2% 100PF	4822 122 31316
C 4029	2% 100PF	4822 122 31316
C 4101	-20+50% 10NF	4822 122 31414
C 4103	-20+50% 10NF	4822 122 31414
C 4105	63V 10% 100NF	5322 121 43083
C 4106	-10+50% 150UF	4822 124 20672
C 4107	-20+50% 10NF	4822 122 31414
C 4108	2% 100PF	4822 122 31316
C 4109	-20+50% 10NF	4822 122 31414
C 4110	63V 10% 470NF	5322 121 43085
C 4112	-20+50% 10NF	4822 122 31414
C 4113	630V 1% 1NF	4822 121 50591
C 4114	100V 10% 10UF	5322 121 41727
C 4116	10% 1.5NF	4822 122 31169
C 4117	2% 100PF	4822 122 31316
C 4118	-20+50% 10NF	4822 122 31414
C 4120	100V 10% 47NF	5322 121 43088
C 4122	63V 10% 100NF	5322 121 43083
C 4123	-10+50% 47UF	4822 124 20699
C 4124	-20+50% 10NF	4822 122 31414
C 4126	-10+50% 47UF	4822 124 20699
C 4301	63V 10% 100NF	5322 121 43083
C 4302	-10+50% 4.7UF	4822 124 20726
C 4303	100V 10% 10NF	5322 121 43086
C 4304	2% 330PF	4822 122 31353
C 4306	-20+50% 10NF	4822 122 31414
C 4307	-20+50% 10NF	4822 122 31414
C 4311	2% 100PF	4822 122 31316
C 4501	-20+50% 10NF	4822 122 31414
C 4502	-20+50% 10NF	4822 122 31414
C 4503	0.25PF 3.9PF	5322 122 34107
C 4521	63V 10% 100NF	5322 121 43083
C 4601	63V 10% 100NF	5322 121 43083
C 4602	0.25PF 8.2PF	4822 122 31052
C 4603	0.25PF 8.2PF	4822 122 31052
C 4611	-20+50% 10NF	4822 122 31414
C 4612	-20+50% 10NF	4822 122 31414

POSNR	DESCRIPTION	ORDERING CODE
C 4613	2% 10PF	4822 122 32185
C 4701	10% 1NF	4822 122 30027
C 4702	63V 10% 100NF	5322 121 43083
C 4703	10% 1NF	4822 122 30027
C 4704	-20+50% 10NF	4822 122 31414
C 4804	-10+50% 150UF	4822 124 20672
C 4807	-20+50% 10NF	4822 122 31414
C 4808	-10+50% 68UF	4822 124 20689
C 4811	-20+50% 10NF	4822 122 31414
C 4812	-10+50% 47UF	4822 124 20699
C 4813	-20+50% 10NF	4822 122 31414
C 4815	-20+50% 10NF	4822 122 31414
C 4819	-20+50% 10NF	4822 122 31414
C 4820	-20+50% 10NF	4822 122 31414
C 4822	-20+50% 10NF	4822 122 31414
C 4825	-20+50% 10NF	4822 122 31414
C 4829	-20+50% 10NF	4822 122 31414
C 4831	-20+50% 10NF	4822 122 31414
C 4832	-10+50% 47UF	4822 124 20699
C 4833	-20+50% 10NF	4822 122 31414
C 4835	-20+50% 10NF	4822 122 31414
C 4836	-20+50% 10NF	4822 122 31414
C 4837	-10+50% 47UF	4822 124 20699
C 4839	2% 12PF	4822 122 31056
C 5001	-20+50% 10NF	4822 122 31414
C 5002	-20+50% 10NF	4822 122 31414
C 5003	-20+50% 10NF	4822 122 31414
C 5004	-20+50% 10NF	4822 122 31414
C 5006	-20+50% 10NF	4822 122 31414
C 6001	250V 10% 220NF	5322 121 44142
C 6002	ME275 20% 1NF	5322 121 42583
C 6003	63V 10% 100NF	5322 121 43083
C 6004	63V 10% 100NF	5322 121 43083
C 6005	-20+50% 1.5NF	5322 122 50092
C 6006	ME275 20% 1NF	5322 121 42583
C 6007	-20+20% 68UF	5322 124 21938
C 6008	-20+20% 68UF	5322 124 21938
C 6009	63V 10% 100NF	5322 121 43083
C 6011	-10+50% 33UF	4822 124 20712
C 6012	2% 220PF	4822 122 30094
C 6013	10% 4.7NF	4822 122 31125
C 6014	160V 1% 33NF	5322 121 50997
C 6017	2000V 5% 1.5NF	4822 121 40541
C 6018	10% 4.7NF	4822 122 31125
C 6031	10% 2.2NF	4822 122 30114
C 6032	63V 10% 220NF	5322 121 43084
C 6033	10% 4.7NF	4822 122 31125
C 6041	63V 10% 100NF	5322 121 43083
C 6042	63V 10% 100NF	5322 121 43083
C 6100	20% 6800UF	4822 124 40692
C 6101	20% 6800UF	4822 124 40692
C 6102	-10+50% 680UF	4822 124 20685
C 6103	-10+50% 680UF	4822 124 20685
C 6104	-10+50% 220UF	4822 124 20681
C 6106	-10+50% 470UF	4822 124 20695
C 6107	-10+50% 150UF	4822 124 20691
C 6108	-10+50% 470UF	4822 124 20695
C 6109	-10+50% 150UF	4822 124 20691
C 6111	-10+50% 220UF	4822 124 20704
C 6112	-10+50% 100UF	4822 124 20701
C 6113	-10+50% 100UF	4822 124 20701
C 6114	-10+50% 100UF	4822 124 20701
C 6116	-10+50% 68UF	4822 124 20734
C 6117	-10+50% 22UF	4822 124 20731
C 6119	-10+50% 22UF	4822 124 20731
C 6120	-20+50% 10NF	4822 122 31414
C 6121	-10+50% 22UF	4822 124 20731
C 6122	630V 1% 680PF	5322 121 51214
C 6131	63V 10% 470NF	5322 121 43085
C 6132	-10+50% 100UF	4822 124 20679
C 6133	63V 10% 100NF	5322 121 43083
C 6134	10% 1NF	4822 122 30027
C 6135	-20+50% 10NF	4822 122 31414
C 6201	100V 10% 47NF	5322 121 43088
C 6202	2% 47PF	4822 122 31072
C 6203	63V 10% 220NF	5322 121 43084
C 6204	63V 10% 100NF	5322 121 43083
C 6205	100V 10% 22NF	5322 121 43087
C 6206	10% 1NF	4822 122 30027
C 6207	10% 4.7NF	4822 122 31125
C 6208	-10+50% 68UF	4822 124 20734
C 6209	-20+50% 2.2NF	5322 122 50093
C 6211	-20+50% 10NF	5322 122 50091
C 6212	-10+10% 33PF	5322 122 33081
C 6213	10% 4.7NF	4822 122 31125
C 6214	20% 470PF	5322 122 50086
C 6311	-20+50% 10NF	4822 122 31414
C 6312	-20+50% 10NF	4822 122 31414
C 6401	63V 10% 100NF	5322 121 43083
C 6402	-10+50% 68UF	4822 124 20689

POSNR	DESCRIPTION	ORDERING CODE
C 6500	-10+50% 68UF	4822 124 20689
C 6501	-20+50% 10NF	4822 122 31414
C 6502	100V 10% 10NF	5322 121 43086
C 6503	2% 100PF	4822 122 31316
C 6506	2% 100PF	4822 122 31316
C 7001	63V 10% 220NF	5322 121 43084
C 7002	2% 39PF	4822 122 31069
C 7003	2% 39PF	4822 122 31069
C 7004	-20+50% 10NF	4822 122 31414
C 7005	63V 10% 100NF	5322 121 43083
C 7006	-20+50% 10NF	4822 122 31414
C 7007	63V 10% 100NF	5322 121 43083
C 7008	10% 680PF	4822 122 30053
C 7009	63V 10% 100NF	5322 121 43083
C 7011	-20+50% 10NF	4822 122 31414
C 7012	-20+50% 10NF	4822 122 31414
C 7013	-20+50% 10NF	4822 122 31414
C 7017	-20+50% 10NF	4822 122 31414
C 7019	-20+50% 10NF	4822 122 31414
C 7100	-20+50% 10NF	4822 122 31414
C 7101	63V 10% 100NF	5322 121 43083
C 7102	63V 10% 220NF	5322 121 43084
C 7103	-20+50% 10NF	4822 122 31414
C 7104	-10+50% 68UF	4822 124 20689
C 7106	-10+50% 68UF	4822 124 20689

16.4.2 RESISTORS

R 201	0.3W 25% 2K2	5322 105 20033
R 202	MRS25 1% 16K2	5322 116 53589
R 203	MRS25 1% 1K33	5322 116 53512
R 204	MRS25 1% 1K33	5322 116 53512
R 206	MRS25 1% 100E	5322 116 53126
R 207	MRS25 1% 100E	5322 116 53126
R 208	MRS25 1% 7K5	4822 116 53028
R 209	0,3W 25% 2K2	5322 105 20033
R 211	MRS25 1% 348E	5322 116 53591
R 213	MRS25 1% 51E1	5322 116 53213
R 214	MRS25 1% 23K7	5322 116 53537
R 216	MRS25 1% 287E	5322 116 53221
R 217	MRS25 1% 287E	5322 116 53221
R 218	MRS25 1% 100E	5322 116 53126
R 219	MRS25 1% 825E	5322 116 53541
R 221	MRS25 1% 6K19	5322 116 53263
R 221	MRS25 1% 1K78	5322 116 53208
R 223	0,3W 25% 470E	5322 105 20028
R 224	MRS25 1% 10E	4822 116 52891
R 226	MRS25 1% 825E	5322 116 53541
R 227	MRS25 1% 1K33	5322 116 53512
R 228	MRS25 1% 287E	5322 116 53221
R 229	MRS25 1% 51E1	5322 116 53213
R 231	MRS25 1% 1K21	4822 116 52956
R 232	MRS25 1% 1K	4822 116 53108
R 233	MRS25 1% 348E	5322 116 53591
R 251	MRS25 1% 5E11	4822 116 52999
R 252	MRS25 1% 5E11	4822 116 52999
R 253	MRS25 1% 5E11	4822 116 52999
R 401	MRS25 1% 10E	4822 116 52891
R 402	MRS25 1% 10E	4822 116 52891
R 403	MRS25 1% 100E	5322 116 53126
R 404	MRS25 1% 100E	5322 116 53126
R 406	MRS25 1% 1E	4822 116 52976
R 407	MRS25 1% 10E	4822 116 52891
R 408	MRS25 1% 5K11	5322 116 53494
R 409	MRS25 1% 5K11	5322 116 53494
R 411	MRS25 1% 1K	4822 116 53108
R 421	MRS25 1% 5E11	4822 116 52999
R 422	MRS25 1% 5E11	4822 116 52999
R 423	MRS25 1% 5E11	4822 116 52999
R 1001	MRS25 1% 1K	4822 116 53108
R 1002	MRS25 1% 42E2	5322 116 53515
R 1003	MRS25 1% 61E9	5322 116 53645
R 1004	0.25% 10K1	5322 116 53404
R 1006	MRS25 1% 61E9	5322 116 53645
R 1007	0.25% 900K	5322 116 53414
R 1008	MRS25 1% 10K	4822 116 53022
R 1009	MRS25 1% 21K5	5322 116 53241
R 1011	0.25% 111K	5322 116 53409
R 1012	0.25% 750K	5322 116 53588
R 1013	0.25% 1M	5322 116 53398
R 1014	MRS25 1% 10K	4822 116 53022
R 1016	MRS25 1% 21K5	5322 116 53241
R 1017	0.25% 250K	5322 116 53587
R 1018	MRS25 1% 10E	4822 116 52891
R 1019	0.25% 990K	5322 116 53415
R 1022	MRS25 1% 61E9	5322 116 53645
R 1023	VR25 10% 22M	5322 116 51785
R 1024	MRS25 1% 10E	4822 116 52891
R 1026	MRS25 1% 51E1	5322 116 53213
R 1027	VR25 10% 22M	5322 116 51785

POSNR	DESCRIPTION	ORDERING CODE
R 1028	MRS25 1% 10E	4822 116 52891
R 1029	0.25% 1M	5322 116 53398
R 1031	VR25 10% 22M	5322 116 51785
R 1032	MRS25 1% 10E	4822 116 52891
R 1033	VR25 10% 22M	5322 116 51785
R 1034	MRS25 1% 1M	4822 116 52843
R 1035	MRS25 1% 100E	5322 116 53126
R 1036	0.3W 25% 22K	5322 105 20035
R 1037	MRS25 1% 100K	4822 116 52973
R 1038	VR25 10% 22M	5322 116 51785
R 1039	MRS25 1% 1K96	5322 116 53237
R 1040	MRS25 1% 287E	5322 116 53221
R 1041	MRS25 1% 1K96	5322 116 53237
R 1043	MRS25 1% 100E	5322 116 53126
R 1044	MRS25 1% 825E	5322 116 53541
R 1045	MRS25 1% 100E	5322 116 53126
R 1046	MRS25 1% 511E	5322 116 53135
R 1047	MRS25 1% 2K15	5322 116 53239
R 1048	MRS25 1% 5K11	5322 116 53494
R 1049	MRS25 1% 1K47	5322 116 53185
R 1050	MRS25 1% 100E	5322 116 53126
R 1051	MRS25 1% 681E	4822 116 53123
R 1052	MRS25 1% 1K78	5322 116 53208
R 1053	0.25% 250E	5322 116 53406
R 1054	MRS25 1% 100E	5322 116 53126
R 1055	MRS25 1% 1K78	5322 116 53208
R 1056	0.25% 375E	5322 116 53407
R 1057	0.25% 150E	5322 116 53399
R 1058	0.25% 150E	5322 116 53399
R 1061	MRS25 1% 237E	5322 116 53259
R 1062	MRS25 1% 133E	5322 116 53424
R 1063	MRS25 1% 26K1	5322 116 53261
R 1064	0.3W 25% 10K	4822 105 10455
R 1066	MRS25 1% 16K2	5322 116 53589
R 1067	MRS25 1% 12K1	4822 116 52957
R 1068	MRS25 1% 133E	5322 116 53424
R 1069	0.3W 25% 100E	5322 105 20029
R 1071	MRS25 1% 26K1	5322 116 53261
R 1072	0.3W 25% 10K	4822 105 10455
R 1073	MRS25 1% 4K64	5322 116 53212
R 1074	MRS25 1% 5K62	5322 116 53495
R 1076	0.3W 25% 100E	5322 105 20029
R 1077	MRS25 1% 31E6	5322 116 54964
R 1078	MRS25 1% 12K1	4822 116 52957
R 1079	MRS25 1% 1K62	5322 116 53257
R 1081	MRS25 1% 511E	5322 116 53135
R 1082	MRS25 1% 100K	4822 116 52973
R 1083	MRS25 1% 11K	4822 116 52907
R 1084	MRS25 1% 82K5	5322 116 53581
R 1086	MRS25 1% 12K1	4822 116 52957
R 1087	MRS25 1% 1M	4822 116 52843
R 1088	MRS25 1% 100E	5322 116 53126
R 1089	MRS25 1% 422E	5322 116 53592
R 1091	0.3W 25% 100E	5322 105 20029
R 1092	MRS25 1% 10E	4822 116 52891
R 1093	MRS25 1% 422E	5322 116 53592
R 1094	MRS25 1% 100E	5322 116 53126
R 1096	MRS25 1% 100E	5322 116 53126
R 1097	MRS25 1% 100E	5322 116 53126
R 1098	MRS25 1% 1K21	4822 116 52956
R 1099	MRS25 1% 1K21	4822 116 52956
R 1101	MRS25 1% 1K	4822 116 53108
R 1102	MRS25 1% 42E2	5322 116 53515
R 1103	MRS25 1% 61E9	5322 116 53645
R 1104	0.25% 10K1	5322 116 53404
R 1106	MRS25 1% 61E9	5322 116 53645
R 1107	0.25% 900K	5322 116 53414
R 1108	MRS25 1% 10K	4822 116 53022
R 1109	MRS25 1% 21K5	5322 116 53241
R 1111	0.25% 111K	5322 116 53409
R 1112	0.25% 750K	5322 116 53588
R 1113	0.25% 1M	5322 116 53398
R 1114	MRS25 1% 10K	4822 116 53022
R 1116	MRS25 1% 21K5	5322 116 53241
R 1117	0.25% 250K	5322 116 53587
R 1118	MRS25 1% 10E	4822 116 52891
R 1119	0.25% 990K	5322 116 53415
R 1122	MRS25 1% 61E9	5322 116 53645
R 1123	VR25 10% 22M	5322 116 51785
R 1124	MRS25 1% 10E	4822 116 52891
R 1126	MRS25 1% 51E1	5322 116 53213
R 1127	VR25 10% 22M	5322 116 51785
R 1128	MRS25 1% 10E	4822 116 52891
R 1129	0.25% 1M	5322 116 53398
R 1131	VR25 10% 22M	5322 116 51785
R 1132	MRS25 1% 10E	4822 116 52891
R 1133	VR25 10% 22M	5322 116 51785
R 1134	MRS25 1% 1M	4822 116 52843
R 1135	MRS25 1% 100E	5322 116 53126
R 1136	0.3W 25% 22K	5322 105 20035
R 1137	MRS25 1% 100K	4822 116 52973
R 1138	VR25 10% 22M	5322 116 51785
R 1139	MRS25 1% 1K96	5322 116 53237
R 1140	MRS25 1% 287E	5322 116 53221
R 1141	MRS25 1% 1K96	5322 116 53237
R 1143	MRS25 1% 100E	5322 116 53126
R 1144	MRS25 1% 825E	5322 116 53541
R 1145	MRS25 1% 100E	5322 116 53126
R 1146	MRS25 1% 511E	5322 116 53135
R 1147	MRS25 1% 2K15	5322 116 53239
R 1148	MRS25 1% 5K11	5322 116 53494
R 1149	MRS25 1% 1K47	5322 116 53185
R 1150	MRS25 1% 100E	5322 116 53126
R 1151	MRS25 1% 681E	4822 116 53123
R 1152	MRS25 1% 1K78	5322 116 53208
R 1153	0.25% 250E	5322 116 53406
R 1154	MRS25 1% 100E	5322 116 53126
R 1155	MRS25 1% 1K78	5322 116 53208
R 1156	0.25% 375E	5322 116 53407
R 1157	0.25% 150E	5322 116 53399
R 1158	0.25% 150E	5322 116 53399
R 1161	MRS25 1% 237E	5322 116 53259
R 1162	MRS25 1% 133E	5322 116 53424
R 1163	MRS25 1% 26K1	5322 116 53261
R 1164	0.3W 25% 10K	4822 105 10455
R 1166	MRS25 1% 16K2	5322 116 53589
R 1167	MRS25 1% 12K1	4822 116 52957
R 1168	MRS25 1% 133E	5322 116 53424
R 1169	0.3W 25% 100E	5322 105 20029
R 1171	MRS25 1% 26K1	5322 116 53261
R 1172	0.3W 25% 10K	4822 105 10455
R 1173	MRS25 1% 4K64	5322 116 53212
R 1174	MRS25 1% 5K62	5322 116 53495
R 1176	0.3W 25% 100E	5322 105 20029
R 1177	MRS25 1% 31E6	5322 116 54964
R 1178	MRS25 1% 12K1	4822 116 52957
R 1179	MRS25 1% 1K62	5322 116 53257
R 1181	MRS25 1% 511E	5322 116 53135
R 1182	MRS25 1% 100K	4822 116 52973
R 1183	MRS25 1% 11K	4822 116 52907
R 1184	MRS25 1% 82K5	5322 116 53581
R 1186	MRS25 1% 12K1	4822 116 52957
R 1187	MRS25 1% 1M	4822 116 52843
R 1188	MRS25 1% 100E	5322 116 53126
R 1189	MRS25 1% 422E	5322 116 53592
R 1191	0.3W 25% 100E	5322 105 20029
R 1192	MRS25 1% 10E	4822 116 52891
R 1193	MRS25 1% 422E	5322 116 53592
R 1194	MRS25 1% 100E	5322 116 53126
R 1196	MRS25 1% 100E	5322 116 53126
R 1197	MRS25 1% 100E	5322 116 53126
R 1198	MRS25 1% 1K21	4822 116 52956
R 1199	MRS25 1% 1K21	4822 116 52956
R 1201	MRS25 1% 1K	4822 116 53108
R 1202	MRS25 1% 61E9	5322 116 53645
R 1203	0.1% 1M	5322 116 51605
R 1204	VR25 10% 22M	5322 116 51785
R 1206	MRS25 1% 1K96	5322 116 53237
R 1207	MRS25 1% 100E	5322 116 53126
R 1208	MRS25 1% 825E	5322 116 53541
R 1209	MRS25 1% 1M	4822 116 52843
R 1211	MRS25 1% 100E	5322 116 53126
R 1213	MRS25 1% 1M	4822 116 52843
R 1217	0.3W 25% 22K	5322 105 20035
R 1218	MRS25 1% 100K	4822 116 52973
R 1219	MRS25 1% 1K47	5322 116 53185
R 1221	MRS25 1% 681E	4822 116 53123
R 1222	MRS25 1% 2K87	5322 116 53513
R 1223	MRS25 1% 1K33	5322 116 53512
R 1224	MRS25 1% 1K	4822 116 53108
R 1226	MRS25 1% 5K11	5322 116 53494
R 1227	MRS25 1% 1K33	5322 116 53512
R 1228	MRS25 1% 100E	5322 116 53126
R 1229	MRS25 1% 750E	5322 116 53265
R 1231	MRS25 1% 750E	5322 116 53265
R 1232	MRS25 1% 1E	4822 116 52976
R 1233	MRS25 1% 348E	5322 116 53591
R 1234	MRS25 1% 100E	5322 116 53126
R 1236	MRS25 1% 162E	5322 116 53523
R 1237	MRS25 1% 2K61	5322 116 53327
R 1238	MRS25 1% 100E	5322 116 53126
R 1239	MRS25 1% 7K5	4822 116 53028
R 1401	MRS25 1% 5E11	4822 116 52999
R 1402	MRS25 1% 5E11	4822 116 52999
R 1403	MRS25 1% 5E11	4822 116 52999
R 1404	MRS25 1% 5E11	4822 116 52999
R 1421	MRS25 1% 5E11	4822 116 52999
R 1422	MRS25 1% 5E11	4822 116 52999
R 1423	MRS25 1% 5E11	4822 116 52999
R 1424	MRS25 1% 5E11	4822 116 52999

POSNR	DESCRIPTION	ORDERING CODE
R 1441	MRS25 1% 100E	5322 116 53126
R 1442	MRS25 1% 5E11	4822 116 52999
R 1443	MRS25 1% 5E11	4822 116 52999
R 2001	MRS25 1% 10E	4822 116 52891
R 2002	MRS25 1% 10E	4822 116 52891
R 2003	MRS25 1% 51E1	5322 116 53213
R 2004	MRS25 1% 51E1	5322 116 53213
R 2101	MRS25 1% 10E	4822 116 52891
R 2102	MRS25 1% 10E	4822 116 52891
R 2103	MRS25 1% 51E1	5322 116 53213
R 2104	MRS25 1% 51E1	5322 116 53213
R 2201	MRS25 1% 75K	5322 116 53266
R 2202	MRS25 1% 12K1	4822 116 52957
R 2203	MRS25 1% 215K	5322 116 53425
R 2204	MRS25 1% 10K	4822 116 53022
R 2205	MRS25 1% 2K15	5322 116 53239
R 2206	MRS25 1% 75K	5322 116 53266
R 2207	MRS25 1% 12K1	4822 116 52957
R 2208	MRS25 1% 215K	5322 116 53425
R 2209	MRS25 1% 10K	4822 116 53022
R 2210	MRS25 1% 2K15	5322 116 53239
R 2211	MRS25 1% 5K62	5322 116 53495
R 2212	0.3W 25% 10K	4822 105 10455
R 2213	MRS25 1% 23K7	5322 116 53537
R 2214	MRS25 1% 10K	4822 116 53022
R 2215	MRS25 1% 2K15	5322 116 53239
R 2216	MRS25 1% 5K62	5322 116 53495
R 2222	MRS25 1% 1K96	5322 116 53237
R 2225	MRS25 1% 23K7	5322 116 53537
R 2230	MRS25 1% 147E	5322 116 53569
R 2231	MRS25 1% 422E	5322 116 53592
R 2232	MRS25 1% 383E	5322 116 53332
R 2234	MRS25 1% 42E2	5322 116 53515
R 2236	MRS25 1% 681E	4822 116 53123
R 2237	MRS25 1% 383E	5322 116 53332
R 2239	MRS25 1% 348E	5322 116 53591
R 2241	MRS25 1% 1K	4822 116 53108
R 2242	MRS25 1% 383E	5322 116 53332
R 2243	MRS25 1% 681E	4822 116 53123
R 2244	MRS25 1% 42E2	5322 116 53515
R 2246	MRS25 1% 422E	5322 116 53592
R 2247	MRS25 1% 383E	5322 116 53332
R 2251	MRS25 1% 75E	5322 116 53339
R 2252	MRS25 1% 750E	5322 116 53265
R 2253	MRS25 1% 750E	5322 116 53265
R 2254	MRS25 1% 75E	5322 116 53339
R 2255	MRS25 1% 287E	5322 116 53221
R 2301	MRS25 1% 19K6	5322 116 53258
R 2302	MRS25 1% 19K6	5322 116 53258
R 2303	MRS25 1% 5K62	5322 116 53495
R 2304	MRS25 1% 5K62	5322 116 53495
R 2311	MRS25 1% 2K87	5322 116 53513
R 2317	MRS25 1% 681E	4822 116 53123
R 2318	MRS25 1% 681E	4822 116 53123
R 2319	MRS25 1% 5E11	4822 116 52999
R 2324	MRS25 1% 5K62	5322 116 53495
R 2325	MRS25 1% 5K62	5322 116 53495
R 2326	MRS25 1% 2K87	5322 116 53513
R 2327	MRS25 1% 3K83	4822 116 53079
R 2328	MRS25 1% 2K87	5322 116 53513
R 2329	MRS25 1% 825E	5322 116 53541
R 2330	0.3W 25% 10K	4822 105 10455
R 2333	MRS25 1% 5K62	5322 116 53495
R 2334	MRS25 1% 5K62	5322 116 53495
R 2335	MRS25 1% 10K	4822 116 53022
R 2336	MRS25 1% 31E6	5322 116 54964
R 2337	MRS25 1% 162E	5322 116 53523
R 2338	MRS25 1% 2K61	5322 116 53327
R 2339	MRS25 1% 237E	5322 116 53259
R 2341	MRS25 1% 31E6	5322 116 54964
R 2342	MRS25 1% 162E	5322 116 53523
R 2344	MRS25 1% 511E	5322 116 53135
R 2345	MRS25 1% 100E	5322 116 53126
R 2346	MRS25 1% 681E	4822 116 53123
R 2348	MRS25 1% 8K25	5322 116 53267
R 2350	MRS25 1% 4K22	5322 116 53246
R 2351	MRS25 1% 562E	5322 116 53214
R 2352	MRS25 1% 825E	5322 116 53541
R 2357	MRS25 1% 681E	4822 116 53123
R 2358	MRS25 1% 511E	5322 116 53135
R 2360	MRS25 1% 100E	5322 116 53126
R 2361	MRS25 1% 4K22	5322 116 53246
R 2365	MRS25 1% 23K7	5322 116 53537
R 2366	MRS25 1% 10K	4822 116 53022
R 2367	MRS25 1% 16K2	5322 116 53589
R 2369	MRS25 1% 68K1	5322 116 53338
R 2371	MRS25 1% 422E	5322 116 53592
R 2372	MRS25 1% 511E	5322 116 53135
R 2373	MRS25 1% 75K	5322 116 53266
R 2374	MRS25 1% 511E	5322 116 53135
R 2375	MRS25 1% 23K7	5322 116 53537
R 2376	VR25 10% 22M	5322 116 51785
R 2377	VR25 10% 22M	5322 116 51785
R 2378	VR25 10% 22M	5322 116 51785
R 2379	VR25 10% 22M	5322 116 51785

POSNR	DESCRIPTION	ORDERING CODE
R 2380	MRS25 1% 750E	5322 116 53265
R 2381	MRS25 1% 2K61	5322 116 53327
R 2382	MRS25 1% 2K61	5322 116 53327
R 2383	MRS25 1% 1K	4822 116 53108
R 2384	MRS25 1% 750E	5322 116 53265
R 2386	MRS25 1% 1K	4822 116 53108
R 2387	MRS25 1% 750E	5322 116 53265
R 2388	MRS25 1% 1K	4822 116 53108
R 2389	MRS25 1% 1K	4822 116 53108
R 2391	MRS25 1% 42E2	5322 116 53515
R 2393	MRS25 1% 3K48	4822 116 53315
R 2394	MRS25 1% 100E	5322 116 53126
R 2395	0.3W 25% 220E	5322 105 20031
R 2396	MRS25 1% 3K48	4822 116 53315
R 2397	MRS25 1% 42E2	5322 116 53515
R 2398	MRS25 1% 237E	5322 116 53259
R 2403	MRS25 1% 42E2	5322 116 53515
R 2404	MRS25 1% 1K33	5322 116 53512
R 2406	MRS25 1% 1K62	5322 116 53257
R 2408	MRS25 1% 1K33	5322 116 53512
R 2409	MRS25 1% 1K62	5322 116 53257
R 2411	MRS25 1% 42E2	5322 116 53515
R 2412	MRS25 1% 1K33	5322 116 53512
R 2416	MRS25 1% 1K	4822 116 53108
R 2418	MRS25 1% 4K22	5322 116 53246
R 2419	MRS25 1% 1K1	5322 116 53473
R 2420	MRS25 1% 825E	5322 116 53541
R 2421	MRS25 1% 4K22	5322 116 53246
R 2422	MRS25 1% 1K	4822 116 53108
R 2430	MRS25 1% 100K	4822 116 52973
R 2431	MRS25 1% 100K	4822 116 52973
R 2432	MRS25 1% 100K	4822 116 52973
R 2433	MRS25 1% 100K	4822 116 52973
R 2434	MRS25 1% 10K	4822 116 53022
R 2435	MRS25 1% 10K	4822 116 53022
R 2601	MRS25 1% 3K48	4822 116 53315
R 2602	MRS25 1% 5E11	4822 116 52999
R 2603	MRS25 1% 5K11	5322 116 53494
R 2604	MRS25 1% 5K11	5322 116 53494
R 2605	MRS25 1% 12K1	4822 116 52957
R 2606	MRS25 1% 1E	4822 116 52976
R 2610	MRS25 1% 10K	4822 116 53022
R 2611	MRS25 1% 1K	4822 116 53108
R 2621	MRS25 1% 422E	5322 116 53592
R 2622	MRS25 1% 681E	4822 116 53123
R 2623	MRS25 1% 1K1	5322 116 53473
R 2624	MRS25 1% 3K48	4822 116 53315
R 2625	MRS25 1% 681E	4822 116 53123
R 2626	MRS25 1% 6K81	5322 116 53252
R 2627	MRS25 1% 287E	5322 116 53221
R 2628	MRS25 1% 2K37	5322 116 53536
R 2629	MRS25 1% 10K	4822 116 53022
R 2631	MRS25 1% 10K	4822 116 53022
R 2632	MRS25 1% 383E	5322 116 53332
R 2635	MRS25 1% 10K	4822 116 53022
R 2701	MRS25 1% 1E	4822 116 52976
R 2702	MRS25 1% 31E6	5322 116 54964
R 2704	MRS25 1% 5E11	4822 116 52999
R 2712	MRS25 1% 5E11	4822 116 52999
R 2713	MRS25 1% 5E11	4822 116 52999
R 2714	MRS25 1% 5E11	4822 116 52999
R 2721	MRS25 1% 5E11	4822 116 52999
R 2722	MRS25 1% 1E	4822 116 52976
R 2723	MRS25 1% 5E11	4822 116 52999
R 2724	MRS25 1% 5E11	4822 116 52999
R 2740	MRS25 1% 5E11	4822 116 52999
R 2741	MRS25 1% 31E6	5322 116 54964
R 2742	MRS25 1% 5E11	4822 116 52999
R 3001	MRS25 1% 147E	5322 116 53569
R 3002	MRS25 1% 316E	5322 116 53514
R 3003	MRS25 1% 1K47	5322 116 53185
R 3004	MRS25 1% 422E	5322 116 53592
R 3006	MRS25 1% 2K37	5322 116 53536
R 3007	0.3W 25% 2K2	5322 105 20033
R 3008	MRS25 1% 121E	4822 116 52955
R 3009	MRS25 1% 3K83	4822 116 53079
R 3011	MRS25 1% 121E	4822 116 52955
R 3012	MRS25 1% 316E	5322 116 53514
R 3013	0.3W 25% 10K	4822 105 10455
R 3014	MRS25 1% 2K87	5322 116 53513
R 3015	MRS25 1% 316E	5322 116 53514
R 3016	MRS25 1% 2K37	5322 116 53536
R 3017	0.3W 25% 22K	5322 105 20035
R 3018	MRS25 1% 8K25	5322 116 53267
R 3020	MRS25 1% 10E	4822 116 52891
R 3021	MRS25 1% 464E	5322 116 53232
R 3022	MRS25 1% 750E	5322 116 53265
R 3023	MRS25 1% 348E	5322 116 53591
R 3024	MRS25 1% 750E	5322 116 53265
R 3025	MRS25 1% 10E	4822 116 52891
R 3026	MRS25 1% 464E	5322 116 53232
R 3027	MRS25 1% 42E2	5322 116 53515
R 3028	MRS25 1% 42E2	5322 116 53515
R 3029	MRS25 1% 3K16	4822 116 53021
R 3031	MRS25 1% 402E	5322 116 53639

POSNR	DESCRIPTION	ORDERING CODE
R 3032	MRS25 1% 31E6	5322 116 54964
R 3033	MRS25 1% 100E	5322 116 53126
R 3034	MRS25 1% 162E	5322 116 53523
R 3036	0.3W 25% 100E	5322 105 20029
R 3037	MRS25 1% 100E	5322 116 53126
R 3038	0.3W 25% 470E	5322 105 20028
R 3039	MRS25 1% 42E2	5322 116 53515
R 3041	MRS25 1% 316E	5322 116 53514
R 3042	MRS25 1% 110E	4822 116 52906
R 3043	MRS25 1% 110E	4822 116 52906
R 3044	MRS25 1% 110E	4822 116 52906
R 3046	MRS25 1% 110E	4822 116 52906
R 3047	MRS25 1% 42E2	5322 116 53515
R 3048	MRS25 1% 42E2	5322 116 53515
R 3049	MRS25 1% 100K	4822 116 52973
R 3050	MRS25 1% 42E2	5322 116 53515
R 3051	MRS25 1% 100K	4822 116 52973
R 3052	MRS25 1% 42E2	5322 116 53515
R 3060	MRS25 1% 110E	4822 116 52906
R 3061	MRS25 1% 110E	4822 116 52906
R 3062	MRS25 1% 110E	4822 116 52906
R 3063	MRS25 1% 110E	4822 116 52906
R 3064	MRS25 1% 110E	4822 116 52906
R 3066	MRS25 1% 110E	4822 116 52906
R 3067	MRS25 1% 110E	4822 116 52906
R 3068	MRS25 1% 110E	4822 116 52906
R 3100	MRS25 1% 42E2	5322 116 53515
R 3101	MRS25 1% 5K62	5322 116 53495
R 3102	MRS25 1% 562E	5322 116 53214
R 3103	MRS25 1% 1K21	4822 116 52956
R 3104	MRS25 1% 6K81	5322 116 53252
R 3106	MRS25 1% 42E2	5322 116 53515
R 3107	MRS25 1% 2K87	5322 116 53513
R 3108	MRS25 1% 825E	5322 116 53541
R 3109	MRS25 1% 6K19	5322 116 53263
R 3110	MRS25 1% 42E2	5322 116 53515
R 3111	MRS25 1% 42E2	5322 116 53515
R 3112	MRS25 1% 7K5	4822 116 53028
R 3113	MRS25 1% 1K21	4822 116 52956
R 3114	MRS25 1% 5K62	5322 116 53495
R 3115	MRS25 1% 42E2	5322 116 53515
R 3116	MRS25 1% 562E	5322 116 53214
R 3117	MRS25 1% 4K64	5322 116 53212
R 3118	0.3W 25% 1K	5322 105 20032
R 3119	MRS25 1% 4K64	5322 116 53212
R 3120	MRS25 1% 42E2	5322 116 53515
R 3121	MRS25 1% 46K4	5322 116 53314
R 3122	MRS25 1% 6K81	5322 116 53252
R 3124	MRS25 1% 619E	5322 116 53337
R 3125	MRS25 1% 42E2	5322 116 53515
R 3126	MRS25 1% 14K7	4822 116 53531
R 3127	MRS25 1% 1K33	5322 116 53512
R 3128	MRS25 1% 825E	5322 116 53541
R 3129	MRS25 1% 1K1	5322 116 53473
R 3130	MRS25 1% 42E2	5322 116 53515
R 3131	MRS25 1% 1K33	5322 116 53512
R 3132	MRS25 1% 825E	5322 116 53541
R 3133	MRS25 1% 6K19	5322 116 53263
R 3134	MRS25 1% 14K7	4822 116 53531
R 3136	MRS25 1% 1K	4822 116 53108
R 3137	MRS25 1% 46K4	5322 116 53314
R 3138	MRS25 1% 6K81	5322 116 53252
R 3139	MRS25 1% 619E	5322 116 53337
R 3141	MRS25 1% 316E	5322 116 53514
R 3142	MRS25 1% 316E	5322 116 53514
R 3143	MRS25 1% 10E	4822 116 52891
R 3144	MRS25 1% 10E	4822 116 52891
R 3147	0.5W 10% 3K3	5322 116 30234
R 3148	MRS25 1% 9K09	5322 116 53253
R 3200	MRS25 1% 6K81	5322 116 53252
R 3201	MRS25 1% 1K21	4822 116 52956
R 3202	MRS25 1% 100E	5322 116 53126
R 3203	MRS25 1% 16K2	5322 116 53589
R 3204	MRS25 1% 562E	5322 116 53214
R 3205	MRS25 1% 4K64	5322 116 53212
R 3206	MRS25 1% 4K64	5322 116 53212
R 3207	MRS25 1% 82K5	5322 116 53581
R 3208	MRS25 1% 7K5	4822 116 53028
R 3209	MRS25 1% 1K	4822 116 53108
R 3210	MRS25 1% 42E2	5322 116 53515
R 3211	MRS25 1% 10K	4822 116 53022
R 3212	MRS25 1% 1K47	5322 116 53185
R 3213	MRS25 1% 23K7	5322 116 53537
R 3214	MRS25 1% 31K6	5322 116 53262
R 3215	MRS25 1% 4K64	5322 116 53212
R 3216	MRS25 1% 178K	5322 116 53555
R 3217	MRS25 1% 511E	5322 116 53135
R 3218	MRS25 1% 61K9	5322 116 53233
R 3219	MRS25 1% 1M	4822 116 52843
R 3221	MRS25 1% 100E	5322 116 53126

POSNR	DESCRIPTION	ORDERING CODE
R 3222	MRS25 1% 100K	4822 116 52973
R 3223	MRS25 1% 38K3	4822 116 53526
R 3224	MRS25 1% 2K37	5322 116 53536
R 3226	MRS25 1% 100E	5322 116 53126
R 3250	MRS25 1% 2K37	5322 116 53536
R 3251	MRS25 1% 1M	4822 116 52843
R 3253	MRS25 1% 75K	5322 116 53266
R 3254	MRS25 1% 1K	4822 116 53108
R 3256	MRS25 1% 178K	5322 116 53555
R 3257	MRS25 1% 825K	5322 116 53341
R 3258	VR25 5% 3M3	4822 110 72201
R 3259	VR25 5% 3M3	4822 110 72201
R 3261	VR25 5% 3M3	4822 110 72201
R 3262	VR25 5% 7M5	5322 116 60131
R 3263	VR25 5% 3M3	4822 110 72201
R 3267	25% 47K	5322 105 20037
R 3268	MRS25 1% 681K	5322 116 53593
R 3269	MRS25 1% 15K4	5322 116 53234
R 3270	MRS25 1% 23K7	5322 116 53537
R 3271	MRS25 1% 14K7	4822 116 53531
R 3273	MRS25 1% 215K	5322 116 53425
R 3301	MRS25 1% 10E	4822 116 52891
R 3302	MRS25 1% 1E	4822 116 52976
R 3303	MRS25 1% 5E11	4822 116 52999
R 3304	MRS25 1% 5E11	4822 116 52999
R 3306	MRS25 1% 2K87	5322 116 53513
R 3308	MRS25 1% 10E	4822 116 52891
R 3309	MRS25 1% 5E11	4822 116 52999
R 3311	MRS25 1% 5E11	4822 116 52999
R 3312	MRS25 1% 5E11	4822 116 52999
R 3313	MRS25 1% 10E	4822 116 52891
R 4000	MRS25 1% 51E1	5322 116 53213
R 4001	MRS25 1% 619E	5322 116 53337
R 4002	MRS25 1% 511E	5322 116 53135
R 4003	MRS25 1% 511E	5322 116 53135
R 4004	MRS25 1% 6K19	5322 116 53263
R 4005	MRS25 1% 100E	5322 116 53126
R 4006	MRS25 1% 51E1	5322 116 53213
R 4007	MRS25 1% 1K47	5322 116 53185
R 4008	MRS25 1% 100E	5322 116 53126
R 4009	0.3W 25% 1K	5322 105 20032
R 4010	MRS25 1% 511E	5322 116 53135
R 4011	MRS25 1% 5K11	5322 116 53494
R 4012	MRS25 1% 1K78	5322 116 53208
R 4013	MRS25 1% 1M	4822 116 52843
R 4014	MRS25 1% 5K11	5322 116 53494
R 4015	MRS25 1% 1K	4822 116 53108
R 4016	MRS25 1% 5K11	5322 116 53494
R 4017	MRS25 1% 2K87	5322 116 53513
R 4018	MRS25 1% 5K11	5322 116 53494
R 4019	MRS25 1% 681K	5322 116 53593
R 4020	MRS25 1% 1K62	5322 116 53257
R 4021	MRS25 1% 10K	4822 116 53022
R 4022	MRS25 1% 4K22	5322 116 53246
R 4023	MRS25 1% 12K1	4822 116 52957
R 4024	MRS25 1% 1K	4822 116 53108
R 4025	MRS25 1% 1K	4822 116 53108
R 4026	MRS25 1% 5K11	5322 116 53494
R 4051	MRS25 1% 10K	4822 116 53022
R 4052	MRS25 1% 10K	4822 116 53022
R 4101	MRS25 1% 100K	4822 116 52973
R 4102	MRS25 1% 4K64	5322 116 53212
R 4103	MRS25 1% 11K	4822 116 52907
R 4104	MRS25 1% 46K4	5322 116 53314
R 4106	MRS25 1% 422E	5322 116 53592
R 4107	0.3W 25% 10K	4822 105 10455
R 4108	0.3W 25% 10K	4822 105 10455
R 4109	MRS25 1% 5K11	5322 116 53494
R 4111	MRS25 1% 12K1	4822 116 52957
R 4117	MRS25 1% 3K16	4822 116 53021
R 4118	0.25% 50E	5322 116 53405
R 4119	0.25% 50E	5322 116 53405
R 4120	MRS25 1% 1K	4822 116 53108
R 4121	0.25% 150E	5322 116 53399
R 4122	0.25% 250E	5322 116 53406
R 4123	0.25% 500E	5322 116 53408
R 4124	0.25% 1K5	5322 116 53401
R 4125	MRS25 1% 100E	5322 116 53126
R 4126	MRS25 1% 9K09	5322 116 53253
R 4127	MRS25 1% 1K62	5322 116 53257
R 4128	MRS25 1% 1K	4822 116 53108
R 4129	MRS25 1% 1M	4822 116 52843
R 4130	MRS25 1% 1K	4822 116 53108
R 4131	MRS25 1% 5K11	5322 116 53494
R 4132	MRS25 1% 5K11	5322 116 53494
R 4133	MRS25 1% 1K	4822 116 53108
R 4134	MRS25 1% 10K	4822 116 53022
R 4135	MRS25 1% 1K	4822 116 53108
R 4136	MRS25 1% 10K	4822 116 53022
R 4137	MRS25 1% 14K7	4822 116 53531
R 4138	MRS25 1% 5E11	4822 116 52999

POSNR	DESCRIPTION	ORDERING CODE
R 4139	MRS25 1% 10K	4822 116 53022
R 4140	MRS25 1% 10K	4822 116 53022
R 4141	MRS25 1% 14K7	4822 116 53531
R 4142	MRS25 1% 100E	5322 116 53126
R 4143	0.1% 20K	5322 116 52697
R 4144	0.1% 202E	5322 116 53413
R 4145	MRS25 1% 1K	4822 116 53108
R 4146	MRS25 1% 10K	4822 116 53022
R 4147	MRS25 1% 511E	5322 116 53135
R 4148	MRS25 1% 21K5	5322 116 53241
R 4149	MRS25 1% 31E6	5322 116 54964
R 4150	MRS25 1% 9E09	5322 116 53516
R 4151	MRS25 1% 2K61	5322 116 53327
R 4152	MRS25 1% 162E	5322 116 53523
R 4153	MRS25 1% 1K1	5322 116 53473
R 4154	MRS25 1% 1K78	5322 116 53208
R 4155	MRS25 1% 2K15	5322 116 53239
R 4156	MRS25 1% 1M	4822 116 52843
R 4157	MRS25 1% 1E	4822 116 52976
R 4158	MRS25 1% 1M	4822 116 52843
R 4159	MRS25 1% 2K15	5322 116 53239
R 4160	MRS25 1% 100E	5322 116 53126
R 4161	MRS25 1% 10K	4822 116 53022
R 4162	MRS25 1% 100E	5322 116 53126
R 4163	MRS25 1% 5E11	4822 116 52999
R 4301	MRS25 1% 51K1	4822 116 53121
R 4302	MRS25 1% 51K1	4822 116 53121
R 4303	MRS25 1% 6K81	5322 116 53252
R 4304	MRS25 1% 5K11	5322 116 53494
R 4305	MRS25 1% 51K1	4822 116 53121
R 4306	MRS25 1% 681E	4822 116 53123
R 4307	MRS25 1% 5K11	5322 116 53494
R 4308	MRS25 1% 10K	4822 116 53022
R 4309	MRS25 1% 8K25	5322 116 53267
R 4310	MRS25 1% 100E	5322 116 53126
R 4311	MRS25 1% 10K	4822 116 53022
R 4312	MRS25 1% 9K09	5322 116 53253
R 4314	MRS25 1% 8K25	5322 116 53267
R 4330	MRS25 1% 5K11	5322 116 53494
R 4331	MRS25 1% 21K5	5322 116 53241
R 4332	MRS25 1% 4K22	5322 116 53246
R 4334	MRS25 1% 2K15	5322 116 53239
R 4501	MRS25 1% 13K3	5322 116 53489
R 4502	MRS25 1% 4K22	5322 116 53246
R 4503	MRS25 1% 6K81	5322 116 53252
R 4504	MRS25 1% 13K3	5322 116 53489
R 4505	MRS25 1% 511E	5322 116 53135
R 4506	MRS25 1% 2K15	5322 116 53239
R 4507	MRS25 1% 750E	5322 116 53265
R 4508	MRS25 1% 11K	4822 116 52907
R 4509	MRS25 1% 2K15	5322 116 53239
R 4513	MRS25 1% 1K47	5322 116 53185
R 4523	MRS25 1% 16K2	5322 116 53589
R 4524	MRS25 1% 14K7	4822 116 53531
R 4526	MRS25 1% 2K37	5322 116 53536
R 4527	MRS25 1% 19K6	5322 116 53258
R 4528	MRS25 1% 5K62	5322 116 53495
R 4529	MRS25 1% 21K5	5322 116 53241
R 4531	MRS25 1% 10K	4822 116 53022
R 4532	MRS25 1% 10K	4822 116 53022
R 4533	MRS25 1% 3K48	4822 116 53315
R 4601	MRS25 1% 2K37	5322 116 53536
R 4602	MRS25 1% 26K1	5322 116 53261
R 4603	MRS25 1% 23K7	5322 116 53537
R 4604	MRS25 1% 100K	4822 116 52973
R 4606	MRS25 1% 909E	4822 116 53533
R 4607	MRS25 1% 100E	5322 116 53126
R 4608	MRS25 1% 1K	4822 116 53108
R 4609	MRS25 1% 42E2	5322 116 53515
R 4611	MRS25 1% 10K	4822 116 53022
R 4612	MRS25 1% 7K5	4822 116 53028
R 4613	MRS25 1% 7K5	4822 116 53028
R 4614	MRS25 1% 8K25	5322 116 53267
R 4616	0.3W 25% 1K	5322 105 20032
R 4617	MRS25 1% 6K81	5322 116 53252
R 4618	MRS25 1% 11K	4822 116 52907
R 4619	MRS25 1% 51K1	4822 116 53121
R 4620	MRS25 1% 10K	4822 116 53022
R 4621	MRS25 1% 909E	4822 116 53533
R 4622	MRS25 1% 100E	5322 116 53126
R 4625	MRS25 1% 100E	5322 116 53126
R 4626	MRS25 1% 100E	5322 116 53126
R 4627	MRS25 1% 10K	4822 116 53022
R 4628	MRS25 1% 100E	5322 116 53126
R 4629	MRS25 1% 8K25	5322 116 53267
R 4631	MRS25 1% 1K	4822 116 53108
R 4632	MRS25 1% 100E	5322 116 53126
R 4633	MRS25 1% 1K	4822 116 53108
R 4634	MRS25 1% 1K	4822 116 53108
R 4636	MRS25 1% 1M	4822 116 52843

POSNR	DESCRIPTION	ORDERING CODE
R 4639	MRS25 1% 383E	5322 116 53332
R 4701	MRS25 1% 42E2	5322 116 53515
R 4703	MRS25 1% 562E	5322 116 53214
R 4705	MRS25 1% 1K	4822 116 53108
R 4706	MRS25 1% 100E	5322 116 53126
R 4707	MRS25 1% 511E	5322 116 53135
R 4708	MRS25 1% 2K87	5322 116 53513
R 4709	MRS25 1% 681E	4822 116 53123
R 4711	MRS25 1% 6K19	5322 116 53263
R 4712	MRS25 1% 511E	5322 116 53135
R 4713	MRS25 1% 1M	4822 116 52843
R 4714	MRS25 1% 1M	4822 116 52843
R 4716	MRS25 1% 6K81	5322 116 53252
R 4717	MRS25 1% 8K25	5322 116 53267
R 4718	MRS25 1% 1K	4822 116 53108
R 4719	MRS25 1% 100E	5322 116 53126
R 4721	0.3W 25% 1K	5322 105 20032
R 4722	MRS25 1% 46K4	5322 116 53314
R 4723	MRS25 1% 681K	5322 116 53593
R 4724	MRS25 1% 42E2	5322 116 53515
R 4725	MRS25 1% 4K22	5322 116 53246
R 4726	MRS25 1% 100K	4822 116 52973
R 4727	MRS25 1% 6K81	5322 116 53252
R 4728	MRS25 1% 562E	5322 116 53214
R 4801	MRS25 1% 5E11	4822 116 52999
R 4804	MRS25 1% 5E11	4822 116 52999
R 4807	MRS25 1% 5E11	4822 116 52999
R 4809	MRS25 1% 5E11	4822 116 52999
R 4819	MRS25 1% 5E11	4822 116 52999
R 4820	MRS25 1% 5E11	4822 116 52999
R 4822	MRS25 1% 5E11	4822 116 52999
R 4825	MRS25 1% 5E11	4822 116 52999
R 4829	MRS25 1% 5E11	4822 116 52999
R 4831	MRS25 1% 5E11	4822 116 52999
R 4833	MRS25 1% 5E11	4822 116 52999
R 4835	MRS25 1% 5E11	4822 116 52999
R 4836	MRS25 1% 5E11	4822 116 52999
R 4838	MRS25 1% 100E	5322 116 53126
R 4839	MRS25 1% 100E	5322 116 53126
R 4841	MRS25 1% 10K	4822 116 53022
R 4902	MRS25 1% 1E	4822 116 52976
R 4903	MRS25 1% 1E	4822 116 52976
R 4904	MRS25 1% 1E	4822 116 52976
R 5001	PP17 20% 10K	5322 101 30546
R 5002	PP17 20% 10K	5322 101 30547
R 5003	PP17 20% 10K	5322 101 30546
R 5004	PP17 20% 10K	5322 101 30546
R 6001	1.7A 20% 82E	4822 116 30069
R 6002	MRS25 1% 383K	5322 116 53576
R 6003	MRS25 1% 383K	5322 116 53576
R 6004	MRS25 1% 316E	5322 116 53514
R 6005	MRS25 1% 464E	5322 116 53232
R 6006	MRS25 1% 10K	4822 116 53022
R 6007	MRS25 1% 10K	4822 116 53022
R 6008	MRS25 1% 316E	5322 116 53514
R 6009	0.5W 10% 1K5	4822 116 30248
R 6010	MRS25 1% 14K7	4822 116 53531
R 6011	MRS25 1% 237E	5322 116 53259
R 6012	MRS25 1% 178E	5322 116 53572
R 6013	MRS25 1% 100E	5322 116 53126
R 6014	MRS25 1% 3E16	4822 116 52993
R 6016	MRS25 1% 10K	4822 116 53022
R 6017	MRS25 1% 1E	4822 116 52976
R 6018	MRS25 1% 1E	4822 116 52976
R 6019	MRS25 1% 10K	4822 116 53022
R 6020	MRS25 1% 21E5	5322 116 53426
R 6021	MRS25 1% 10K	4822 116 53022
R 6022	MRS25 1% 10K	4822 116 53022
R 6031	MRS25 1% 383E	5322 116 53332
R 6032	0.25% 5K62	5322 116 80473
R 6033	0.25% 7K5	5322 116 80474
R 6034	MRS25 1% 6K19	5322 116 53263
R 6036	MRS25 1% 7K5	4822 116 53028
R 6037	MRS25 1% 31K6	5322 116 53262
R 6038	MRS25 1% 100E	5322 116 53126
R 6039	MRS25 1% 10E	4822 116 52891
R 6041	MRS25 1% 3K83	4822 116 53079
R 6042	MRS25 1% 3K83	4822 116 53079
R 6043	MRS25 1% 100K	4822 116 52973
R 6044	MRS25 1% 100K	4822 116 52973
R 6101	MRS25 1% 100E	5322 116 53126
R 6102	MRS25 1% 100E	5322 116 53126
R 6103	MRS25 1% 1K	4822 116 53108
R 6131	MRS25 1% 10E	4822 116 52891
R 6132	MRS25 1% 100K	4822 116 52973
R 6133	MRS25 1% 100K	4822 116 52973
R 6134	MRS25 1% 1K	4822 116 53108
R 6136	MRS25 1% 4K64	5322 116 53212
R 6137	MRS25 1% 316E	5322 116 53514
R 6138	MRS25 1% 1K	4822 116 53108

POSNR	DESCRIPTION	ORDERING CODE
R 6139	MRS25 1% 100E	5322 116 53126
R 6201	0.25% 160K	5322 116 53412
R 6202	VR37 1% 31M6	5322 116 64103
R 6203	MRS25 1% 100K	4822 116 52973
R 6204	MRS25 1% 10K	4822 116 53022
R 6205	MRS25 1% 1K	4822 116 53108
R 6206	MRS25 1% 16K2	5322 116 53589
R 6207	MRS25 1% 51E1	5322 116 53213
R 6208	MRS25 1% 464E	5322 116 53232
R 6209	MRS25 1% 4K64	5322 116 53212
R 6211	MRS25 1% 46K4	5322 116 53314
R 6212	MRS25 1% 4K64	5322 116 53212
R 6213	MRS25 1% 215E	5322 116 53325
R 6214	VR25 5% 10M	4822 110 72214
R 6216	MRS25 1% 100E	5322 116 53126
R 6217	MRS25 1% 1E	4822 116 52976
R 6300	MRS25 1% 2K61	5322 116 53327
R 6301	MRS25 1% 464E	5322 116 53232
R 6302	MRS25 1% 909E	4822 116 53533
R 6303	MRS25 1% 3K83	4822 116 53079
R 6304	MRS25 1% 6K81	5322 116 53252
R 6311	MRS25 1% 750E	5322 116 53265
R 6312	MRS25 1% 4K22	5322 116 53246
R 6313	MRS25 1% 1K1	5322 116 53473
R 6401	MRS25 1% 1K78	5322 116 53208
R 6402	MRS25 1% 178K	5322 116 53555
R 6403	MRS25 1% 215E	5322 116 53325
R 6404	MRS25 1% 6K81	5322 116 53252
R 6406	MRS25 1% 26K1	5322 116 53261
R 6407	MRS25 1% 3K48	4822 116 53315
R 6408	MTP10 20% 10K	5322 100 10113
R 6501	MRS25 1% 511E	5322 116 53135
R 6502	MRS25 1% 100K	4822 116 52973
R 6503	MRS25 1% 5K11	5322 116 53494
R 6504	MRS25 1% 19K6	5322 116 53258
R 6506	MRS25 1% 5K62	5322 116 53495
R 6507	MRS25 1% 511E	5322 116 53135
R 6508	0.25% 3K67	5322 116 53411
R 6509	0.25% 500E	5322 116 53408
R 6511	MRS25 1% 562E	5322 116 53214
R 7005	PP17 20% 10K	5322 101 30546
R 7006	PP17 20% 10K	5322 101 30546
R 7007	PP17 20% 10K	5322 101 30546
R 7008	PP17 20% 10K	5322 101 30546
R 7009	PP17 20% 10K	5322 101 30546
R 7010	PP17 20% 10K	5322 101 30546
R 7011	PP17 20% 10K	5322 101 30546
R 7012	PP17 20% 10K	5322 101 30546
R 7021	MRS25 1% 11K	4822 116 52907
R 7022	MRS25 1% 10K	4822 116 53022
R 7023	MRS25 1% 90K9	5322 116 53582
R 7024	MRS25 1% 1K	4822 116 53108
R 7025	MRS25 1% 1K	4822 116 53108
R 7026	MRS25 1% 4K64	5322 116 53212
R 7027	MRS25 1% 3K83	4822 116 53079
R 7028	MRS25 1% 3K83	4822 116 53079
R 7029	MRS25 1% 1K	4822 116 53108
R 7031	MRS25 1% 1K	4822 116 53108
R 7032	MRS25 1% 75K	5322 116 53266
R 7033	MRS25 1% 5K11	5322 116 53494
R 7034	MRS25 1% 162E	5322 116 53523
R 7036	0.5W 10% 2K2	4822 116 30254
R 7037	MRS25 1% 1K1	5322 116 53473
R 7038	MRS25 1% 1M	4822 116 52843
R 7041	MRS25 1% 3K83	4822 116 53079
R 7042	MRS25 1% 3K83	4822 116 53079
R 7102	MRS25 1% 100E	5322 116 53126
R S001	MCR18 1% 10K	4822 111 90249

16.4.3 COILS

L 1001	0.22UH 10%	5322 157 53284
L 1101	0.22UH 10%	5322 157 53284
L 1401	1500UH	4822 156 21293
L 1402	1500UH	4822 156 21293
L 1403	1500UH	4822 156 21293
L 1421	1500UH	4822 156 21293
L 1422	1500UH	4822 156 21293
L 1423	1500UH	4822 156 21293
L 3001	2.2UH 10%	5322 157 53509
L 3002	2.2UH 10%	5322 157 53509
L 3003	2.7UH 10%	5322 157 53511
L 4101	2.2UH	4822 157 51757
L 6000	100UH	5322 157 52363
L 6001	100UH	5322 157 52363
L 6002	100UH	5322 157 52363
L 6003	5.6UH	4822 157 52259
L 6004	1000UH	5322 157 52718
L 6006	1000UH	5322 157 52718
L 6101	10UH	5322 157 52513
L 6102	27UH	4822 158 10551
L 6103	100UH	5322 157 52363
L 6104	100UH	5322 157 52363
L 6106	82UH	4822 158 10563
L 6107	82UH	4822 158 10563
L 6108	82UH	4822 158 10563
L 6109	82UH	4822 158 10563
L 6111	15UH	5322 157 52539
L 6201	82UH	4822 158 10563
L 6501	82UH	4822 158 10563
L 7101	15UH	5322 157 52539

16.4.4 SEMI-CONDUCTORS

V 201	BAW62	4822 130 30613
V 202	BAW62	4822 130 30613
V 203	BF324 SELECT	5322 693 90465
V 203	BAW62	4822 130 30613
V 206	BF370	4822 130 42589
V 401	BC558B	4822 130 44197
V 402	BC548C	4822 130 44196
V 1000	BA483	4822 130 32656
V 1001	BF324	4822 130 41448
V 1002	BF324	4822 130 41448
V 1003	BF410C	4822 130 41482
V 1004	BA483	4822 130 32656
V 1005	BA483	4822 130 34382
V 1006	BF410C	4822 130 41482
V 1007	BA483	4822 130 32656
V 1008	BA483	4822 130 32656
V 1009	BA483	4822 130 32656
V 1010	BZX79-C8V2	4822 130 34382
V 1011	BF410C	4822 130 41482
V 1012	BA483	4822 130 32656
V 1013	BA483	4822 130 32656
V 1014	BA483	4822 130 32656
V 1016	BF410C	4822 130 41482
V 1017	BA483	4822 130 32656
V 1019	BF199	4822 130 44154
V 1021	BF199	4822 130 44154
V 1022	BF324	4822 130 41448
V 1023	BZX79-C5V6	4822 130 34173
V 1024	BF370	4822 130 42589
V 1061	BAW62	4822 130 30613
V 1062	BAW62	4822 130 30613
V 1063	BF324	4822 130 41448
V 1064	BF324	4822 130 41448
V 1100	BA483	4822 130 32656
V 1101	BF324	4822 130 41448
V 1102	BF324	4822 130 41448
V 1103	BF410C	4822 130 41482
V 1104	BA483	4822 130 32656
V 1105	BA483	4822 130 32656
V 1106	BF410C	4822 130 41482
V 1107	BA483	4822 130 32656
V 1108	BA483	4822 130 32656
V 1109	BA483	4822 130 32656
V 1110	BZX79-C8V2	4822 130 34382
V 1111	BF410C	4822 130 41482
V 1112	BA483	4822 130 32656
V 1113	BA483	4822 130 32656
V 1114	BA483	4822 130 32656
V 1116	BF410C	4822 130 41482
V 1117	BA483	4822 130 32656
V 1119	BF199	4822 130 44154
V 1121	BF199	4822 130 44154
V 1122	BF324	4822 130 41448
V 1123	BZX79-C5V6	4822 130 34173
V 1124	BF370	4822 130 42589
V 1161	BAW62	4822 130 30613
V 1162	BAW62	4822 130 30613
V 1163	BF324	4822 130 41448
V 1164	BF324	4822 130 41448
V 1200	BZV46-C1V5	5322 130 34865
V 1201	BF410C	4822 130 41482
V 1202	BA483	4822 130 32656
V 1203	BA483	4822 130 32656
V 1204	BF199	4822 130 44154
V 1205	BZX79-C8V2	4822 130 34382
V 1206	BF199	4822 130 44154
V 1207	BF324	4822 130 41448
V 1208	BZX79-C5V6	4822 130 34173
V 1209	BF199	4822 130 44154
V 1211	BF324	4822 130 41448
V 1212	BF324	4822 130 41448
V 1213	BF324	4822 130 41448
V 2001	BZV46-C2V0	4822 130 31248
V 2002	BZV46-C2V0	4822 130 31248
V 2003	BZX79-C3V0	4822 130 31881
V 2101	BZV46-C2V0	4822 130 31248
V 2102	BZV46-C2V0	4822 130 31248
V 2103	BZX79-C3V0	4822 130 31881
V 2305	BZV46-C1V5	5322 130 34865
V 2306	BZV46-C1V5	5322 130 34865
V 2308	BZX79-C4V3	4822 130 31554
V 2309	BZX79-C4V3	4822 130 31554

POSNR	DESCRIPTION	ORDERING CODE
V 2310	BC558B	4822 130 44197
V 2311	BC558B	4822 130 44197
V 2313	BAW62	4822 130 30613
V 2314	BAW62	4822 130 30613
V 2314	BC558B	4822 130 44197
V 2316	BF324	4822 130 41448
V 2317	BC548C	4822 130 44196
V 2318	BF324	4822 130 41448
V 2319	BF324	4822 130 41448
V 2321	BF324	4822 130 41448
V 2325	BAW62	4822 130 30613
V 2326	BAW62	4822 130 30613
V 2327	BC558B	4822 130 44197
V 2328	BZX79-C5V1	4822 130 34233
V 2329	BZX79-C9V1	4822 130 30862
V 2331	BC558B	4822 130 44197
V 2332	BC558B	4822 130 44197
V 2333	BC558B	4822 130 44197
V 2334	BC558B	4822 130 44197
V 2341	BF199	4822 130 44154
V 2342	BF199	4822 130 44154
V 2356	BC548C	4822 130 44196
V 2357	BC548C	4822 130 44196
V 2366	BAW62	4822 130 30613
V 2367	BAW62	4822 130 30613
V 2368	BAW62	4822 130 30613
V 2369	BAW62	4822 130 30613
V 2370	BC548C	4822 130 44196
V 2371	BC558B	4822 130 44197
V 2601	BZX79-C6V2	4822 130 34167
V 2602	BC548C	4822 130 44196
V 2611	BF199	4822 130 44154
V 2612	BF199	4822 130 44154
V 2615	BC548C	4822 130 44196
V 2616	BZV46-C1V5	5322 130 34865
V 3001	BF324	4822 130 41448
V 3002	BF324	4822 130 41448
V 3003	BC558B	4822 130 44197
V 3004	BF324	4822 130 41448
V 3006	BF324	4822 130 41448
V 3007	BC548C	4822 130 44196
V 3008	BF370	4822 130 42589
V 3009	BF370	4822 130 42589
V 3011	2N3866-01	5322 130 41799
V 3012	2N3866-01	5322 130 41799
V 3013	BZX79-C27	4822 130 34379
V 3014	BZX79-C27	4822 130 34379
V 3016	BAW62	4822 130 30613
V 3101	BF324	4822 130 41448
V 3102	BF324	4822 130 41448
V 3103	BF324	4822 130 41448
V 3104	BC558B	4822 130 44197
V 3106	BF324	4822 130 41448
V 3108	BF472	5322 130 42535
V 3109	BF370	4822 130 42589
V 3111	BF370	4822 130 42589
V 3112	2N5551	5322 130 44491
V 3113	BZX79-B5V6	4822 130 34173
V 3114	2N5551	5322 130 44491
V 3116	BF472	5322 130 42535
V 3200	BF370	4822 130 42589
V 3201	BF370	4822 130 42589
V 3202	2N5401	5322 130 42534
V 3203	2N5551	5322 130 44491
V 3204	BF423	4822 130 41646
V 3205	BZX79-B5V6	4822 130 34173
V 3206	BAW62	4822 130 30613
V 3207	BC548C	4822 130 44196
V 3208	BF423	4822 130 41646
V 3209	BAW62	4822 130 30613
V 3211	BAW62	4822 130 30613
V 3212	BZX79-C68	4822 130 30864
V 3213	BC548C	4822 130 44196
V 3214	BAW62	4822 130 30613
V 3215	BAW62	4822 130 30613
V 3216	BZX79-C9V1	4822 130 30862
V 3217	BAW62	4822 130 30613
V 3251	BF423	4822 130 41646
V 3252	BZX79-C6V2	4822 130 34167
V 3253	BF423	4822 130 41646
V 3254	BF423	4822 130 41646
V 3256	BF423	4822 130 41646
V 3257	BAV21	4822 130 30842
V 3301	BZX79-C6V2	4822 130 34167
V 4001	BF199	4822 130 44154
V 4002	BF199	4822 130 44154
V 4003	BF199	4822 130 44154
V 4004	BC548C	4822 130 44196
V 4005	BC558B	4822 130 44197
V 4006	BF763	5322 130 61148
V 4007	BAW62	4822 130 30613
V 4008	BAW62	4822 130 30613
V 4009	BC548C	4822 130 44196
V 4011	BZX79-C5V1	4822 130 34233
V 4012	BC548C	4822 130 44196

POSNR	DESCRIPTION	ORDERING CODE
V 4013	BZX79-C3V6	5322 130 34834
V 4014	BAW62	4822 130 30613
V 4016	BC548C	4822 130 44196
V 4017	BC548C	4822 130 44196
V 4018	BC548C	4822 130 44196
V 4101	BC558B	4822 130 44197
V 4102	BAW62	4822 130 30613
V 4103	BAW62	4822 130 30613
V 4104	BC548C	4822 130 44196
V 4106	BAW62	4822 130 30613
V 4107	BC327	4822 130 40854
V 4108	BC548C	4822 130 44196
V 4109	BC558B	4822 130 44197
V 4110	BAW62	4822 130 30613
V 4111	BC558B	4822 130 44197
V 4112	BSX20	4822 130 41705
V 4113	BZV46-C1V5	5322 130 34865
V 4114	BSX20	4822 130 41705
V 4115	BZX79-C6V2	4822 130 34167
V 4116	BAW62	4822 130 30613
V 4117	BC548C	4822 130 44196
V 4118	BC548C	4822 130 44196
V 4119	BF199	4822 130 44154
V 4120	BAW62	4822 130 30613
V 4121	BC548C	4822 130 44196
V 4122	BAW62	4822 130 30613
V 4123	BAW62	4822 130 30613
V 4300	BZX79-C6V2	4822 130 34167
V 4301	BC558B	4822 130 44197
V 4302	BC548C	4822 130 44196
V 4304	BC558B	4822 130 44197
V 4305	BZX79-C9V1	4822 130 30862
V 4306	BAW62	4822 130 30613
V 4307	BC548C	4822 130 44196
V 4308	BZV46-C1V5	5322 130 34865
V 4309	BC548C	4822 130 44196
V 4321	BAW62	4822 130 30613
V 4322	BC548C	4822 130 44196
V 4323	BC548C	4822 130 44196
V 4500	BAW62	4822 130 30613
V 4501	BC548C	4822 130 44196
V 4502	BC548C	4822 130 44196
V 4503	BC548C	4822 130 44196
V 4504	BC548C	4822 130 44196
V 4505	BAW62	4822 130 30613
V 4506	BC548C	4822 130 44196
V 4510	BC558B	4822 130 44197
V 4511	BC558B	4822 130 44197
V 4512	BC558B	4822 130 44197
V 4514	BC558B	4822 130 44197
V 4516	BAW62	4822 130 30613
V 4517	BAW62	4822 130 30613
V 4518	BAW62	4822 130 30613
V 4519	BAW62	4822 130 30613
V 4523	BC548C	4822 130 44196
V 4601	BAW62	4822 130 30613
V 4602	BAW62	4822 130 30613
V 4611	BF199	4822 130 44154
V 4612	BF199	4822 130 44154
V 4613	BAW62	4822 130 30613
V 4614	BAW62	4822 130 30613
V 4616	BC548C	4822 130 44196
V 4702	BF324	4822 130 41448
V 4703	BAW62	4822 130 30613
V 4704	BAW62	4822 130 30613
V 4706	BF324	4822 130 41448
V 4707	BC558B	4822 130 44197
V 4708	BF324	4822 130 41448
V 4709	BC558B	4822 130 44197
V 4710	BC548C	4822 130 44196
V 4711	BAW62	4822 130 30613
V 4712	BF324	4822 130 41448
V 4713	BAW62	4822 130 30613
V 4806	BAX12	5322 130 34605
V 4807	BAX12	5322 130 34605
V 4808	BAX12	5322 130 34605
V 4809	BAX12	5322 130 34605
V 6001	BYV96E	5322 130 34979
V 6002	BYV96E	5322 130 34979
V 6003	BYV96E	5322 130 34979
V 6004	BYV96E	5322 130 34979
V 6007	BAX12	5322 130 34605
V 6008	BAX12	5322 130 34605
V 6009	BC337	4822 130 40855
V 6011	BAX12	5322 130 34605
V 6012	BZX79-C15	4822 130 34281
V 6013	BRY39	5322 130 40482
V 6014	BUZ80	5322 130 43926
V 6016	BYV27-150	4822 130 31628
V 6017	BYV27-150	4822 130 31628
V 6018	BUW12A	5322 130 42114
V 6019	BYV26C	4822 130 32343
V 6021	BZX79-C3V0	4822 130 31881
V 6031	BZX79-C3V6	5322 130 34834
V 6101	BYV43-45	5322 130 33656

POSNR	DESCRIPTION	ORDERING CODE
V 6102	BYV28-150	5322 130 32043
V 6103	BYV27-150	4822 130 31628
V 6104	BYV28-150	5322 130 32043
V 6106	BYV27-150	4822 130 31628
V 6107	BYV95C	4822 130 41487
V 6108	BYV27-150	4822 130 31628
V 6109	BYV95C	4822 130 41487
V 6110	BYV27-150	4822 130 31628
V 6112	BT151-500R	5322 130 24081
V 6113	BYV95C	4822 130 41487
V 6115	BYV27-150	4822 130 31628
V 6116	BYV27-150	4822 130 31628
V 6131	BAX12	5322 130 34605
V 6132	BAW62	4822 130 30613
V 6133	BZX79-C6V2	4822 130 34167
V 6134	BC337	4822 130 40855
V 6136	BF423	4822 130 41646
V 6137	BF423	4822 130 41646
V 6138	BZX79-C5V6	4822 130 34173
V 6201	BC327	4822 130 40854
V 6202	BZX79-C15	4822 130 34281
V 6203	BAV21	4822 130 30842
V 6204	BAV21	4822 130 30842
V 6206	BAV21	4822 130 30842
V 6207	BYV27-150	4322 130 31628
V 6208	BUV26A	5322 130 42722
V 6209	BY509	4822 130 41485
V 6211	BC337	4822 130 40855
V 6301	BC548C	4822 130 44196
V 6302	BC558B	4822 130 44197
V 6303	BC337	4822 130 40855
V 6304	BC327	4822 130 40854
V 6311	BC337	4822 130 40855
V 6312	BDX78	5322 130 44278
V 6401	BZV11	5322 130 34294
V 6402	BAX12	5322 130 34605
V 6403	BC337	4822 130 40855
V 7001	BAW62	4822 130 30613
V 7002	BC548C	4822 130 44196
V 7101	BAW62	4822 130 30613

16.4.5 INTEGRATED CIRCUITS

D 401	PC74HCT132P	4822 209 83044
D 1001	TEA1017/N8	5322 209 70023
D 1061	OQ 0203	5322 209 70393
D 1101	TEA1017/N8	5322 209 70023
D 1161	OQ 0203	5322 209 70393
D 2002	OQ 0205	5322 209 70392
D 2102	OQ 0205	5322 209 70392
D 2201	PLIFIER	5322 209 80991
D 2203	ARRAY OQ 0127	5322 209 80992
D 2301	OQ 0205	5322 209 70392
D 2302	PLIFIER	5322 209 80991
D 2303	PLIFIER	5322 209 80991
D 2304	OQ 0128	5322 209 82925
D 2601	HEF4053BP	5322 209 10576
D 2602	TEA1017/N8	5322 209 70023
D 2603	OQ 0200	5322 209 82924
D 4001	TEA1017/N8	5322 209 70023
D 4002	TEA1017/N8	5322 209 70023
D 4101	HEF4053BP	5322 209 10576
D 4102	HEF4051BP	4822 209 10262
D 4103	OQ 0201	5322 209 72905
D 6501	HEF4066BP	5322 209 10357
D 7001	UP 8052 AH	5322 209 11349
D 7002	HEF4053BP	5322 209 10576
D 7003	PC74HCT259P	5322 209 11115
D 7006	SN74LS244N	5322 209 86017
D 8001	PCF8577T	5322 209 70024
D 8002	PCF8577T	5322 209 70024
D 8003	PCF8577T	5322 209 70024
N 201	CA3127E	5322 130 42627
N 1001	UA714TC	5322 209 70275
N 1101	UA714TC	5322 209 70275
N 1201	LF356N	5322 209 86422
N 4101	LM324N	4822 209 80587
N 4102	UA714TC	5322 209 70275
N 4103	TL080CP	5322 209 72464
N 4601	TCA240	4822 209 80629
N 6001	LM358N	4822 209 70672
N 6002	LM358N	4822 209 70672
N 7001	LM339AN	4822 209 80631

16.4.6 CATHODE RAY TUBE

POSNR	DESCRIPTION	ORDERING CODE
V 0001	D14-372GH	5322 131 20169
V 0001	CRT D14-372GM/123	5322 131 20171

16.4.7 MISCELLANEOUS

D 6201	HT MULTIPLIER	5322 321 21597
E 0001	T13/4 28V 80MA	5322 134 40534
E 8001	60MA MGG9012	5322 134 40849
G 7001	KYO	5322 242 71444
H 6001	CNX35	5322 130 90137
K 1001	EED-RELAIS 12V	5322 280 20125
K 1002	EED-RELAIS 12V	5322 280 20125
K 1003	EED-RELAIS 12V	5322 280 20125
K 1004	EED-RELAIS 12V	5322 280 20125
K 1006	EED-RELAIS 12V	5322 280 20125
K 1007	EED-RELAIS 12V	5322 280 20125
K 1008	EED-RELAIS 12V	5322 280 20125
K 1101	EED-RELAIS 12V	5322 280 20125
K 1102	EED-RELAIS 12V	5322 280 20125
K 1103	EED-RELAIS 12V	5322 280 20125
K 1104	EED-RELAIS 12V	5322 280 20125
K 1106	EED-RELAIS 12V	5322 280 20125
K 1107	EED-RELAIS 12V	5322 280 20125
K 1108	EED-RELAIS 12V	5322 280 20125
K 1201	EED-RELAIS 12V	5322 280 20125
K 4101	EED-RELAIS 12V	5322 280 20125
S 6001		5322 276 11859
S 7002	BR	5322 277 10878
S 7004	BR	5322 277 10878
S 7008	BR	5322 277 10878
S 7012		5322 276 11857
S 7013		5322 276 11856
S 7014		5322 276 11856
S 7015		5322 276 11856
S 7016		5322 276 11856
S 7018		5322 276 11856
S 7019		5322 276 11856
S 7020		5322 276 11856
S 7021		5322 276 11856
S 7022		5322 276 11856
S 7023		5322 276 11856
S 7024		5322 276 11856
S 7025		5322 276 11856
S 7026		5322 276 11856
S 7030		5322 276 11856
S 7031		5322 276 11856
S 7032		5322 276 11856
T 0001	T 5X20 1,6A	4822 253 30024
T 6001	EDT-39 TRANSFORMER	5322 146 30591
T 6201	PG1 TFE30 TRANSFORM.	5322 146 30592

17. OPTIONS

17.1 Y-OUT

17.1.1 Characteristics

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Y-out	via channel A	
Defl. coeff.	100 mV/div. +/- 10%	at R_{load} > 10 kOhm
	50 mV/div. +/- 10%	at R_{load} = 50 Ohm
* Bandwidth	> 50 MHz	
* Pulse aberrations		
LF pulse drop or	< 2%	at R_{load}= 50 Ohm
tilt	< 3%	at R_{load}> 10 kOhm
		5 div. pulse; +or- 2,5 div. from screen centre.
* HF pulse aberrations	< 6%	5 div. pulse (ac coupled)
* Dyn. range	+or- 12 div.	at 10 MHz
	> 6 div	at 50 MHz
* DC output level	0 V	
Output drift ($10^{o}C$-$40^{o}C$)	< 50 mV	

17.1.2 Circuit description

The Y-OUT circuit receives its input current from the signal splitter D2002, pin 6 and 11 on the pre-amplifier unit. The symmetrical input is buffered by two common-base amplifiers V203. These two transistors are matched for a common Vbe to compensate temperature drift.
The symmetrical current signals are then converted into the asymmetrical Y-OUT voltage via the short-feedback amplifier N201-6,7,8. The amplitude of this Y-OUT voltage is the summation of the voltage across resistor R219 and R226. The offset can be adjusted to 0 V by means of potentiometer R201. Transistor V206 serves as the current source of this final stage.

17.1.3 Adjusting and checking procedure

Refer to figure 3.1 for location of the adjusting points.

NOTE: Be sure that the oscilloscope is well adjusted before starting this adjusting procedure.

Gain adjustment:

- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Connect the Y OUT output to input B by means of a coax cable.
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Set UP-DOWN ch. B to 0,1 V.
- Press AC/DC key ch. A for DC input coupling.
- Press AC/DC key ch. B for DC input coupling.
- Press ALT/CHOP key for chopped display.
- Press ADD/INVERT key for a channel A minus channel B display
- Adjust R209 for a straight line display (tolerance: +or- 1,5 subdiv.)

Offset adjustment:

- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Connect the Y OUT output to input B by means of a coax cable.
- Press AUTO SET key.
- Press 0 key ch. A.
- Connect a digital multimeter to the Y-OUT connection of the BNC socket and the BNC-ground.
- Adjust R201 so that the output voltage is 0 V (tolerance: +or- 10 mV)

Checking the gain:

- Apply a 100 mV/1 kHz calibrated square-wave signal to input A.
- Connect the Y OUT output to input B by means of a coax cable.
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Set UP-DOWN ch. B to 0,1 V.
- Press AC/DC key ch. A for DC input coupling.
- Press AC/DC key ch. B for DC input coupling.
- Press A/B key for only ch. B display.
- Ensure that the amplitude of the displayed signal is 5 div. (tolerance: +or- 1,5 subdiv.)
- Terminate ch. B with 50 Ohm.
- Set UP-DOWN ch. B to 50 mV.
- Ensure that the amplitude of the displayed signal is 5 div. (tolerance: +or- 1,5 subdiv.

HF square-wave response adjustment:

- Apply a 120 mV/1 MHz calibrated square-wave signal with rise time faster than 1 nsec to input A.
- Connect the Y OUT output to a PM3295 oscilloscope means of a coax cable. (Input: 50 Ohm, sensitivity: 50 mV/div)
- Press AUTO SET key
- Set UP-DOWN ch. A to 20 mV.
- Press AC/DC key ch. A for DC input coupling.
- Ensure that the PM3295 displays a square wave signal of 6 div p-p approx.
- Adjust R223 and C203 for an optimal square-wave response.

Y-OUT bandwidth check:

- Apply a 120 mV/1 MHz sine-wave to input A.
- Connect the Y-OUT output to a PM3295 oscilloscope by means of a coax cable. (input: 50 Ohm, sensitivity: 50 mV/div).
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Press AC/DC key ch. A for DC input coupling.
- Ensure that the amplitude of the displayed signal of the PM3295 oscilloscope is 6,0 div.; if necessary, readjust the amplitude of the input signal.
- Now, increase the frequency of the input signal to 50 MHz.
- Ensure that the amplitude of the displayed signal on the PM3295 is at least 5,0 div. p-p.

Checking the dynamic range:

- Apply a 0,25 V/50 MHz sine-wave to input A.- Connect the Y-OUT output to PM3295 oscilloscope by means of a coax cable. (input: 50 Ohm, sensitivity: 200 mV/div).
- Press AUTO SET key.
- Set UP-DOWN ch. A to 20 mV.
- Press AC/DC key ch. A for DC input coupling.
- Ensure that the displayed signal is shown without distortion or clipping.
- Change the input signal to 0,52 V/10 MHz sine wave.
- Change UP/DOWN ch. A to 20 mV.
- Ensure that the displayed signal is shown without distortion or clipping.

17.1.4 Parts list

POS.NR	DESCRIPTION	ORDERING CODE
C201	10nF -20+150% 100V	4822 122 31414
C202	100pF -2% 100V	4822 122 31316
C203	10pF TRIM CAP	5322 125 11013
C204	1nF -10% 100V	4822 122 30027
C251	68uF -10+50% 16V	4822 124 20689
C252	10nF -20+50% 100V	4822 122 31414
C253	10nF -20+50% 100V	4822 122 31414
C254	68uF -10+50% 16V	4822 124 20689
C256	10nF -20+50% 100V	4822 122 31414
C257	10nF -20+50% 100V	4822 122 31414
R201	2K2 25% 0,3W	5322 105 20033
R202	16K2 1% MRS25	5322 116 53589
R203	1K33 1% MRS25	5322 116 53512
R204	1K33 1% MRS25	5322 116 53512
R206	100E 1% MRS25	5322 116 53126
R207	100E 1% MRS25	5322 116 53126
R208	7K5 1% MRS25	5322 116 53028
R209	2K2 25% 0,3W	5322 105 20033
R211	348E 1% MRS25	5322 116 53591
R212	51E1 1% MRS25	5322 116 53213

POS.NR	DESCRIPTION	ORDERING CODE
R213	51E1 1% MRS25	5322 116 53213
R214	23K7 1% MRS25	5322 116 53537
R216	287E 1% MRS25	5322 116 53221
R217	287E 1% MRS25	5322 116 53221
R218	100E 1% MRS25	5322 116 53126
R219	825E 1% MRS25	5322 116 53541
R221	6K19 1% MRS25	5322 116 53263
R222	1K78 1% MRS25	5322 116 53208
R223	470E 25% 0,3W	5322 105 20028
R224	10E 1% MRS25	5322 116 52891
R226	825E 1% MRS25	5322 116 53541
R227	1K33 1% MRS25	5322 116 53512
R228	287E 1% MRS25	5322 116 53221
R229	51E1 1% MRS25	5322 116 53213
R231	1K21 1% MRS25	5322 116 52956
R232	1K 1% MRS25	5322 116 53108
R233	348E 1% MRS25	5322 116 53591
R251	5E11 1% MRS25	4822 116 52999
R252	5E11 1% MRS25	4822 116 52999
R253	5E11 1% MRS25	4822 116 52999
V201	BAW62	4822 130 30613
V202	BAW62	4822 130 30613
V203	BF324 select	5322 693 90465
V204	BAW62	4822 130 30613
V206	BF370	4822 130 42589
N201	CA3127E	5322 130 42627
X204	3-P SNG-90°	5322 265 30433
3x	50 Ohm bus conn.	5322 268 24116
3x	50 Ohm pen conn.	5322 268 14141

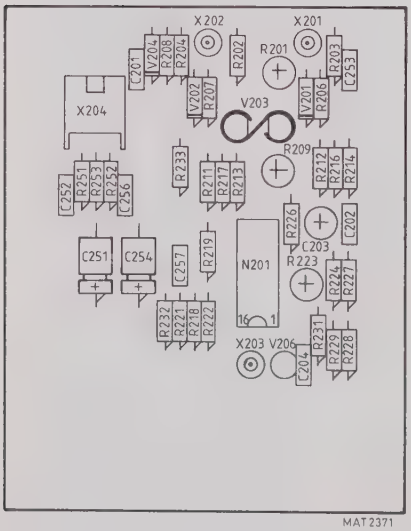
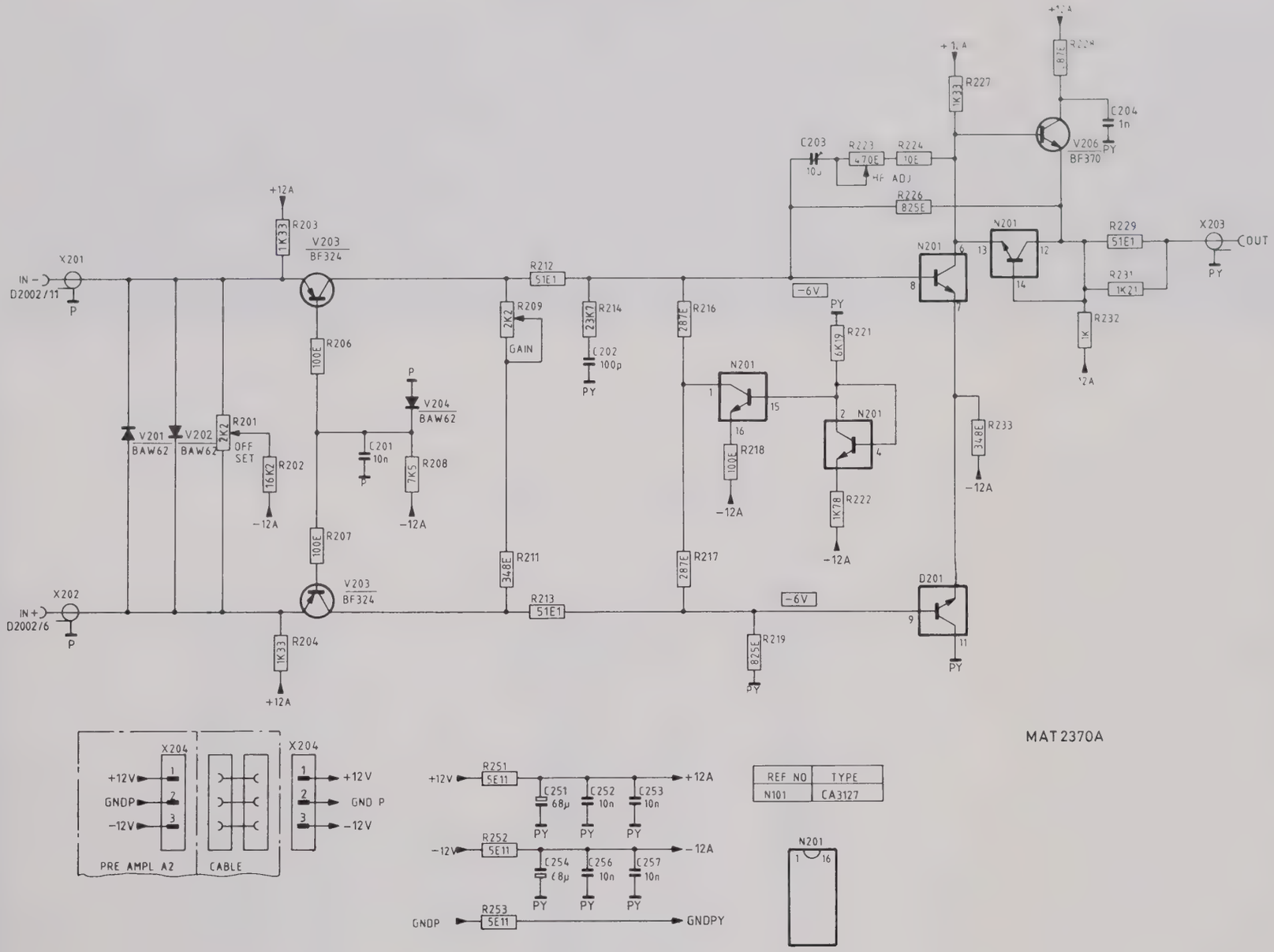


Figure 17.1 Y-OUT p.c.b.



MAT 2370A

REF NO	TYPE
N101	CA3127

Figure 17.2 Circuit diagram of Y-OUT option

17.2 MTB GATE AND MTB SWEEP

17.2.1. MTB gate

The BNC output socket gives a TTL-compatible signal, which is HIGH during the MTB sweep and LOW for other conditions.

Characteristics	Specification	Additional information
* Output voltage LOW	< 0,4 V	at +4 mA
* Output voltage HIGH	> 2,4 V	at -4 mA

17.2.2 MTB sweep

The BNC output socket gives the MTB sawtooth signal.

Characteristics	Specification	Additional information
* Output voltage	0,5 V/div. +or-2,5%	at $R_{load} \geq$ 1 Meg-Ohm
* Linearity	< 3%	for definition, see MTB spec. in this manual.
* Output impedance	1 kOhm +or-2%	
* Offset voltage	< 250 mV	

17.2.3 Parts list

POS.NR	DESCRIPTION	ORDERING CODE
C421	10 nF -20+50% 100 V	4822 122 31414
C422	10 nF -20+50% 100 V	4822 122 31414
C423	10 nF -20+50% 100 V	4822 122 31414
R401	10 E 1% MRS25	5322 116 52891
R402	10 E 1% MRS25	5322 116 52891
R403	100 E 1% MRS25	5322 116 53126
R404	100 E 1% MRS25	5322 116 53126
R406	1 E 1% MRS25	4822 116 52976
R407	10 E 1% MRS25	5322 116 52891
R408	5k11 1% MRS25	5322 116 53494
R409	5k11 1% MRS25	5322 116 53494
R411	1 K 1% MRS25	5322 116 53108
R421	5E11 1% MRS25	5322 116 52999
R422	5E11 1% MRS25	4822 116 52999
R423	5E11 1% MRS25	4822 116 52999
V401	BC558B	4822 130 44197
V402	BC548C	4822 130 44196
D401	PC74HCT132P	4822 209 83044
3x 50 Ohm bus		5322 268 24116
3x 50 Ohm pin		5322 268 14141

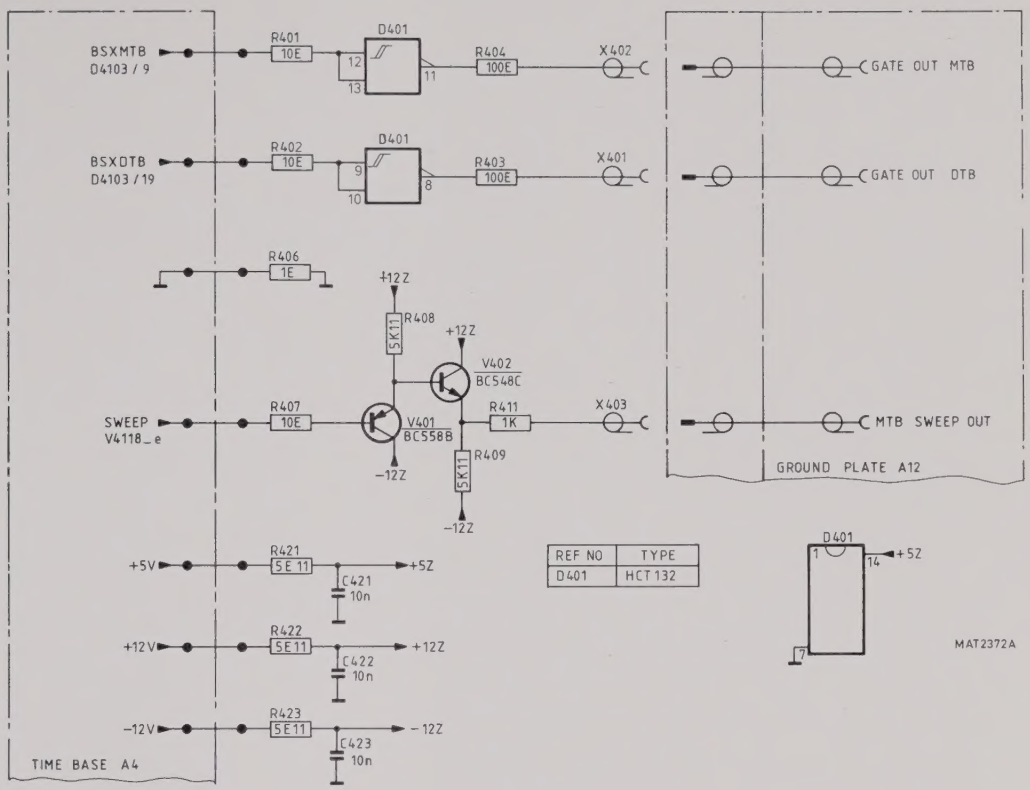


Figure 17.3 Circuit diagram of MTB gate and MTB sweep options

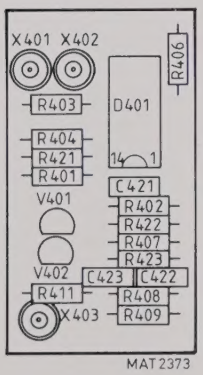


Figure 17.4 P.c.b. for MTB gate and MTB sweep

MP MASTER
MA25281